Functional specifications

Contents

1 Context

1.1 Problem

This project was proposed by Harfang a French company that makes the Harfang3D engine. Harfang3D is a lightweight C++ 3D rendering engine.

Their current solution, which is based on C++, is highly efficient but has a steep learning curve. This leads to longer development cycles for the end user. It may even end up forcing the user to hire or retrain their software engineer.
In order to be more attractive and flexible, Harfang needs to have support for other languages.

They made a Binding system called FABGen which supports Python, LUA and Golang programming language.

The client wants to add support for Rust in FABGen.

1.2 Target and Stakeholders

Our Target is FABGen. The Stakeholders are ALGOSUP and Harfang.

1.3 Concurrency

SWIG is an other existing, widely used, binding system for C and C++. SWIG was not suited to the client needs as it was too old, The availability of features may be limited based on the language selected.

Bindgen is the standard C/C++ to Rust binding tool, it might serve as a stepping stone for the implementation of Rust into FABGen. Bindgen use a different file format than FABGen to describe library so it is unsuitable for the client use.

2 Project scope

2.1 In scope

FABGen is an open source software development tool that connects programs written in C++ with a variety of high-level programming languages. Currently FABGen supports LUA, Python and Go.
Our objective is to add Rust support to FABGen.

2.2 Out of scope

These are the features that were not necessary for a minimum viable product. It does not mean that these features won't be added.

We could try to make the Binding in such a way as to avoid Polymorphism at runtime. This would be better for speed and safety, which are an important aspect of Rust, however, it is not necessary for the minimum goal of the project.

The project is to add Rust support, but if we have extra time after completing the MVP and "no Polymorphism" we could also implement support for a new language. It would however be very time consuming, and not required, which means that we would only start it after everything else is implemented.

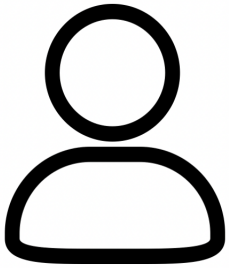
2.2.1 Out of scope table

Features	Reasons for rejection	Date
No Polymorphism at runtime	Not enough time	03/01/2023
Extra language binder	Not enough time	03/01/2023

3 Personas

These are personas that represent potential users.

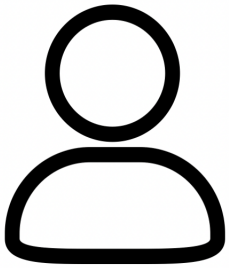
Gunter Kogler



Developer at Microsoft working on MS Flight Simulator physics engine

He made a C++ library for atmospheric physic. He would like to add this library to other language, but SWIG doesn't work for some of his most complex functions. He hopes that FABGen can be an alternative.

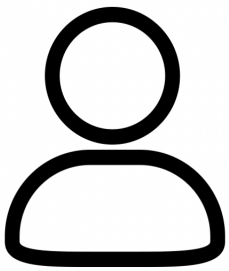
Świętosław Lozowski



Independant software developer & AI engineer

He is developing an AI for sail boats. For that purpose he needs to make a bridge between his AI in python and his environment in C++.

Mary Dass



Developer for a consultant company specialized in VR testing

Her responsibility is to establish a virtual reality test environment for clients using Unity. The company would like to translate some of their data processing code to C for faster execution, but they want to keep the rest of their codebase in C#.

4 Use case

- The user has a C++ library they want to bind to Rust (or another language)
- They write the python description file for their library
- The Program generates the binding and headers for the targeted language
- The user can now import his library into his language of choice

5 Requirements

Feature	Importance
Binding with Rust	Mandatory
Validate unit tests	Important
High reliability	Important
No Polymorphism at runtime	Optional
Working Rust example	Optional

5.1 Binding with Rust

Binding a library to Rust means creating a way to call this library's functions from the Rust programming language.
Binding allows communication between very low level programming languages and higher level programming languages like C to Python which have a simpler syntax and is easier to work with.

5.2 Validate unit tests

FABGen comes with a set of unit tests to validate that most features of a language are properly implemented. We need to write a new set of tests for Rust.

5.3 High reliability

A major feature of Rust is memory safety and reliability. It is very important that we keep both of these features with our Binding.
The Rust implementation must conform to the standard syntax of the language and undergo extensive unit testing..

5.4 No polymorphism at runtime

"Runtime Polymorphism" refers to a program's ability to determine the necessary type at runtime to satisfy a polymorphic interface. Depending on the programming language, this can be relatively simple to implement. However, it can also lead to decreased performance and reduced memory safety.

5.5 Working Rust-Harfang example

To ensure that our Binding is functional, we will need to create a Rust project using our binding and a C++ library. This project should use as many different functions and edge cases as possible. To save time on development, this project will be a Rust version of a pre-existing, completed project.

6 Timeline & Milestones

Deliverable	Date
Functional Specifications	20/01/2023
Rust binding prototype	27/01/2023
Technical Specifications	20/01/2023
Validated unit tests	10/02/2023
Rust example	14/02/2023

Their are also a number of smaller steps to reach our end goal.

- Understand how Bindgen works.
- Understand how FABGen works
- Make unit test for Rust in FA
- Make FABGen work to pass the unit test
- Create a demonstration project using the binding

7 Risks and Assumptions

7.1 Risks

Risk	Danger Level	Mitigation
Difficulty translating example project into Rust	Medium	Downsize the example
Team needs more time to familiarise with Rust	High	Work overtime
FABGen can't run on OSX Rust	High	Use a VM

7.2 Assumptions

- We can base ourselves on the Golang-FABGen implementation
- Validating the unit tests makes our code cover all functions.

Glossary

Binding is a bridge that allow communication between two programming language. 2, 4

C++ is a programming language descendant of C, with the ability to manipulate object-oriented features.. 2

FABGen is a tool to help create library binding between Harfang C++ and other language. 2, 4, 5

Harfang is 3D Real Time Visualization Tools. 2

Polymorphism allows to create functions that accept any type, as long as those types exhibit certain behaviors or properties that we need them to have. 2–4

Rust is a general-purpose programming language.. 2–4