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# **Software Requirements Specification**

**for**

## **PID Manager**

**Version 2.0 approved**

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## Revision History

Name	Date	Reason For Changes	Version
Ricky Chon	10/01/2020	Adding support for multi-threading	2.0

# **1. Introduction**

## **1.1 Purpose**

The goal is to implement a basic PID manager that is capable of allocating and releasing PIDs from a PID map. It is for the purpose of learning how PID managers work in operating systems (Linux-based for this particular scope of the software).

The next iteration of this software supports multi-threading, which will allow the user to allocate and release PIDs on multiple threads.

## **1.2 Document Conventions**

This document follows the IEEE standard for software requirements specification.

## **1.3 Intended Audience and Reading Suggestions**

Developers and project managers are the intended audience of this document. It is recommended to read this document from top to bottom, to go from more generic descriptions to more specific implementations.

## **1.4 Product Scope**

The software is intended to show how a basic PID manager works, and allow developers to learn how to implement the basic functionalities of a PID manager. It is also used to demonstrate the PID manager's support for multi-threading and how it is implemented.

## **1.5 References**

# **2. Overall Description**

## **2.1 Product Perspective**

This product is a standalone PID manager, but should be built with scalability in mind for future iterations.

## **2.2 Product Functions**

The PID manager must be able to do the following:

- Allocate a map for representing PIDs
- Allocate PIDs
- Release PIDs

An API should be available for the user to call functions to perform the above actions.

## **2.3 User Classes and Characteristics**

Student Developers: other students that have this same assignment; they should be able to learn how to install the development tools to run the software, if they don't have them already

Faculty Members: professors that view this assignment and test out the software; more experience and technical expertise, should have the necessary development tools to run the software

## **2.4 Operating Environment**

Any of the major operating systems with gcc/g++ support, as well as support for GNU Make: Windows 10, Mac OS X, Linux. Due to the vast operating environment, multi-threading support should be implemented using the newer C++11 `<thread>` library, as opposed to just the UNIX/Linux `<pthread.h>` or Windows' `<windows.h>`.

## **2.5 Design and Implementation Constraints**

Since the goal is to create software that would be used in an operating system (PID manager), it is recommended to write this software in C/C++, due to its high performance. The current iteration of this software uses threads and future iterations may include optimizations, so it would be best to utilize C libraries. The software's code should conform to C++17 standards.

## **2.6 User Documentation**

Provide a README markdown file containing details and instructions on running the PID manager for end-users, and an INSTRUCTIONS markdown file containing implementation instructions for developers. Developers can use this document alongside the instructions file for reference.

## **2.7 Assumptions and Dependencies**

For the purpose of this assignment, assume that the software will run on any of the major operating systems with gcc/g++ support, as well as support for GNU Make: Windows 10, Mac OS X, Linux

## 3. External Interface Requirements

### 3.1 User Interfaces

A standard UNIX terminal, or any terminal that is able to run gcc/g++ and GNU Make would suffice as a user interface to test out the PID manager's features. The software will take in user input to select which tests to run.

### 3.2 Hardware Interfaces

Any decent computer, laptop, remote server that can run GNU Make and compile C++ code.

### 3.3 Software Interfaces

One strategy the software can adopt is the way Linux handles the availability of process IDs, by having a bitmap where a value of **0** at position **i** would indicate an available process ID, and a value of **1** would indicate a process ID that is currently in use.

### 3.4 Communications Interfaces

## 4. System Features

### 4.1 API - Map Allocation

#### 4.1.1 Description and Priority

- Creates and initializes a data structure for representing PIDs
- High Priority

#### 4.1.2 Stimulus/Response Sequences

- User calls the function `int allocate_map()`
- If map allocation is successful, return 1
- If map allocation is unsuccessful, return -1

#### 4.1.3 Functional Requirements

- REQ-1: range of possible PID values is between 300 and 5000 inclusive
  - `#define MIN_PID 300`
  - `#define MAX_PID 5000`
  - Since we are dealing with a bitmap of integers, an array of integers of fixed size equal to the difference of MAX\_PID and MIN\_PID is a better option for performance compared to a dynamic vector of integers

## 4.2 API - PID Allocation

### 4.2.1 Description and Priority

- Allocates and returns a PID
- High Priority

### 4.2.2 Stimulus/Response Sequences

- User calls the function `int allocate_pid()`
- If unable to allocate a PID (when all PIDs have been allocated), return -1
- If PID allocation is successful, return the PID

### 4.2.3 Functional Requirements

- REQ-1: range of possible PID values is between 300 and 5000 inclusive

## 4.3 API - PID Release

### 4.3.1 Description and Priority

- Releases a PID
- High Priority

### 4.3.2 Stimulus/Response Sequences

- User calls the function `void release_pid(int pid)`
- If the PID is valid, release it (set its value from **1** to **0**)
- If the PID is out of range of MAX\_PID and MIN\_PID, do nothing

### 4.3.3 Functional Requirements

- REQ-1: range of possible PID values is between 300 and 5000 inclusive

## 4.4 Optional Diagnostics Tool

### 4.4.1 Description and Priority

- A tool that outputs useful messages based on two parameters: a test value and the action conducted (Map Allocation, PID Allocation, PID Release)
- Medium Priority

### 4.4.2 Stimulus/Response Sequences

- User calls the function `void output_result(PidAction action, int testValue)`
- If the action is `PidAllocation` (enum), the function will test if the test value is -1
- If the testValue is -1, print an error letting the user know that PID allocation has been unsuccessful, then return with exit code 1
- Otherwise, print a message letting the user know that PID allocation has been successful, along with the PID number that was allocated
- Similar sequences should occur with the other actions

### 4.4.3 Functional Requirements

- REQ-1: the above features must be correctly implemented for the tool to display correct results, since all it does is test the parameters/return values of each function

## 4.5 Multi-Threading Support

### 4.5.1 Description and Priority

- Ability to create and run individual processes on threads concurrently irregardless of the operating environment
- Medium Priority

### 4.5.2 Stimulus/Response Sequences (Multi-Thread Testing)

- Initialize an array of threads
- Allocate PID map for use
- Create and execute the following process on each thread
  - Request PID
  - Sleep for random amount of time
  - Release PID
- Synchronize and join all threads

### 4.5.3 Functional Requirements

- REQ-1: reliable thread library for the specified language used (in this case C/C++)
- REQ-2: threads can't seem to execute functions from an external class, so both the process and thread should ideally be located in the same file

## 5. Other Nonfunctional Requirements

### 5.1 Performance Requirements

### 5.2 Safety Requirements

### 5.3 Security Requirements

### 5.4 Software Quality Attributes

**Maintainability:** easy to understand, repair, and optimize without any breaking changes

**Scalability:** easy to add new features or deprecate old ones

**Reliability:** make sure the implemented features always work as intended

**Testability:** easy to test features without extra hassle

**Ease of use:** easy for developers to pick up and use

**Well documented:** the software API should be well documented to eliminate any confusion on each feature



## **5.5 Business Rules**

# **6. Other Requirements**

The software should be licensed under the [MIT License](#).

## **Appendix A: Glossary**

API: Application Programming Interface

IEEE: Institute of Electrical and Electronics Engineers

PID: Process ID

## **Appendix B: Analysis Models**

## **Appendix C: To Be Determined List**