RCLOCK
The documentation
A digital terminal clock for POSIX platforms

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Chapter 1. CASE Tools

Good software is never built without help, and the Rclock isn’t an exception. Here is a list of softwares that will help the development of this project:

1.1. Visual Studio Code

The Visual Studio Code is a extensible cross-platform code editor that will help the process of coding and debugging the software. Any other code editor is acceptable for work with the Rclock project, however, the code editor has to follow configurations that allow a better interoperability among the editors. The configuration is the following:

- The selected code editor (or even the VS code) must have the Tab Size defined to 4 (spaces).

1.2. GCC compiler

The Gnu Compiler Collection (GCC) is the tool that will be used to generate the final executable, the compiler version in current use on the project is the **13.2.1.**

1.3. Meson

Meson is a build system for a wide set of languages, currently supporting C, C++, D, Fortran, Java, Rust. This build system will be used instead of the Make because of its friendly way of use.

1.4. Draw.io

Draw.io is a prototyping tool for creating software diagrams. This was used to create the Component diagram of this Software.

Chapter 2. Software definition

Here are all the definitions of the software that will be built, this section consists of a set of questions and its answers.

2.1. What is the data that will be manipulated by the software

The main set of data that the Rclock will work on is date and time. Even that the OS can give us the current date and time, the software will also accept a date and a time from the user.

2.2. What is the features and the performance required by the software?

2.2.1. Features

This software has a initial set of required features, divided into three groups. The **User** group, that has features which enable the user to modify the program. The **Clock** group, that is a set of features for the clock itself. The **Project** group, that is a set of technical features for the project.

2.2.1.1. User group

Here is the set of required features for the user group

1. The system shall offer a way for the user to pass configurations flags through the command-line arguments.
2. The system shall be able to make the users choose the zoom of their preference.
3. The system shall exit when the user press Enter.

2.2.1.2. Clock group

Every single clock feature, for example, clock customization and time features are listed here

1. The system shall show the current date beyond the clock itself.
2. The system shall give the possibility of hide the current date.
3. The system shall have the feature of change the clock color.
4. The system shall have the feature of change the date color.
5. The system shall have the feature of change the color of each clock digit.
6. The system shall have the feature of change the color of the colons that split the digits pairs.
7. The system shall offer the customization of the date format using a string.
8. The system shall offer a way to set a custom time for the clock, for hours, minutes and seconds.
9. The system shall use the current time for those segments (hours, minutes and seconds) that weren’t set by a custom time flag.
10. The system shall offer a way to set a custom time using the format: xx:xx:xx.
11. The system shall offer a way to set a custom date for day, month and year.
12. The system shall offer a way to set a custom date using the format: DD/MM/YYYY.
13. The system shall use the current date for those segments (day, month and year) that weren’t set by a custom time flag.
14. The system shall have the feature of hide the seconds of the clock.
15. The system shall realign the clock to the center when the terminal be resized.
16. The system shall hide the seconds if not hidden yet in the case of the terminal be very small horizontally.
17. The system shall show an error message aligned to the center if the terminal is extremely small to support the clock.
18. The system shall show an error message aligned to the center for any error that may occur to the program.
19. The system shall resize the error message as the user resizes the terminal.
20. The system shall hide the date if not hidden yet in the case of the terminal be very small vertically.
21. The system shall calculate the elapsed time when the computer sleeps and update the clock with this value.

2.2.1.3. Project group

1. The system shall implement each clock digit and colon on a separate Ncurses window.
2. The system project shall have a well structured file system.

2.2.2. Performance

The performance of an application is a crucial point while planning and building the application, and for the Rclock it is not different. The clock itself will update each second, however, for responsiveness purposes, the program will be able to update the screen for each 50 elapsed milliseconds.

2.3. Required interfaces

Create interfaces on a terminal is not usual, by default, we would have to handle a couple of events that the window could generate. Using the Ncurses library, the situation gets better when we talk about design an interface and update only specific pieces inside the terminal buffer.

2.3.1. Clock digits

The clock digits, as the main part of the program, will be draw using different background colors. With the great support of colors that the Ncurses offers to the developers, and of course, the support of colors that the terminal that is hosting the application shall have, the design and customization will be great. The clock's look and feel suggests something really digital, the edges of the numbers are squared, but still a beautiful design.

2.3.2. Clock date

As the date is usually shown as a string, on this project it won't be different, the Rclock date will be placed at the bottom of the clock digits, its presence won't change the clock position, that must be always at the center of the terminal.

2.4. Required validation criteria

The validation criteria will be useful for detect any unexpected behavior that the Rclock program may generate, and its validation criteria are based on user input, that changes the normal behavior of the software somehow. Here is all possible user inputs and what they do:

2.4.1 Hiding the date

This flag hide the clock date completely. The clock itself remains unchanged.

Full command: --hide-date
Abbreviation: -h

2.4.2. Changing clock color

This flag changes the color of the entire clock. This flag doesn't affect the date color

Full command: --clock-color <color-name>
Abbreviation -c <color-name>

2.4.3. Changing date color

This flag changes the color of the date displayed bellow the clock

Full command: --date-color <color-name>
Abbreviation: -d <color-name>

2.4.4. Changing the color of specific clock digit

This flag changes the color of a specific clock digit. To specify the correct digit to be customized, a roman number, between I and VI must be part of the flag.

Command: --color-VI <color-name>

2.4.5. Changing the color of the colons

This flag changes the color of the colons that divide the clock segments.

Full command: --colon-color <color-name>
Abbreviation: -o <color-name>

2.4.6. Changing the digits colors

This flag behaves like the –clock-color, but only affect the digits.

Full command: --digits-color <color-name>
Abbreviation: -l <color-name>

2.4.7. Changing the date format

The flag of change date format needs a strftime function format string.

Full command: --date-format <string-in-strftime-function-format>
Abbreviation: -f <string-in-strftime-function-format>

2.4.8. Set a custom time for the clock

The following commands set a custom time to the clock, they change the hours, minutes, seconds and the full time respectively.

Full command: --custom-hour <0-23>
Abbreviation: -H <0-23>

Full command: --custom-minute <0-59>
Abbreviation: -M <0-59>

Full command: --custom-second <0-59>
Abbreviation: -S <0-59>

Full command: --custom-time <xx:xx:xx format>
Abbreviation: -T <xx:xx:xx format>

2.4.9. Set a custom date

The following commands set a custom date to the program, they change the day, month, year and a full date respectively.

Full command: --custom-day <integer>
Abbreviation: -D <month-day>

Full command: --custom-month <integer>
Abbreviation: -O <integer>

Full command: --custom-year <integer>
Abbreviation: -Y <integer>

Full command: --custom-date <DD/MM/YYYY>
Abbreviation: -D <DD/MM/YYYY>

2.4.10. Hide the seconds of the clock

This command hide the seconds of the clock, the clock itself must still aligned to the center.

Full command: --hide-seconds
Abbreviation: -i

Chapter 3. Software construction

Here is all the planning to build the software, its logic, data structures and how will be translated to a programming language in the future.

3.1 Data structures

Here is the collection of all data structures that will be necessary to handle crucial data to the application.

3.1.1. Digits matrix

Draw the clock digits in the buffer may be a challenging part of the logic, even because there's a set of possible numbers between 0 and 9 and each clock digit can be any of them. The digits matrix will be used as an iterable map, that will make it possible to draw the numbers on the terminal.

3.1.1.1. The format of the matrix

The matrix will have three dimensions, the first dimension will be used to define each digit, the index 0 will hold the digit 0, the index 1 will hold the digit 1 and so on… The two remaining dimensions will be used for hold the shape of each digit.

3.1.1.2. Matrix building constants

The matrix will use two macros for better understanding of what’s part of a number and what’s just a empty place in the final buffer. The two macros are de following:

- COLOR - Is a “pixel” of a number, defined by the number 1
- INVIS – Is a empty place, defined by the number 0

3.1.2. Windows array

As said previously in the project’s requirements, each clock digit will be hold by a different Ncurses window, to make the process easier, all windows will be hold by a array, making the process of redraw iterable. The colon windows will be stored in the same array, even because they will also be modified during the run-time.

3.1.3. Colors array

The built-in set of colors that the Rclock supports will be placed inside a array of colors and fetched its existence and its color code when necessary. It is a fact that an array isn’t usually a smart approach, by the reason of its O(n) nature, however, the built-in set of colors isn’t large enough to make a significant difference while running the program.

3.2. Software architecture

This section of the documentation will explain how the project is structured, and show how the modules of the software will work together to achieve the final software described previously.

3.2.1 The project filesystem

The tree of the project is divided into directories, each one holding files of the category described by the directory name.

- **build/ -** directory used by the Meson tool for build the software
- **docs/ -** directory used to store the documentations
- **include/ -** stores all the header files of the program
- **libs/ -** directory used to store the third-party libraries
- **src/ -** directory used to hold all the source code files
- **tests/ -** all tests are done here

3.2.2. Modules

For a better understanding and organization of this project, the source code will be split into modules, each one executing a task that together create the complete program. Each module has its own documentation on a separate file.

3.2.2.1. shapes.c

The shapes.c is a module that stores the clock digits and the colon, everytime that a module of the program needs a digit or a colon shape, the module will need ask for it.

3.2.2.2. datetime.c

The datetime.c is a module that will handle everything that involves dates and time, examples of the module’s job is format, generate/read date and time, clock sleeps and so on.

3.2.2.3. screen-manager.c

The screen-manager.c is a module that will take care of build and prepare the windows and place placeholders to be filled with the contents, that are the digits, colons and the date.

3.2.2.4. design.c

The design.c is a module that will draw the contents on the places given by the screen-manager.c module. The digits, colons and the date are printed here.

3.2.2.5. colors.c

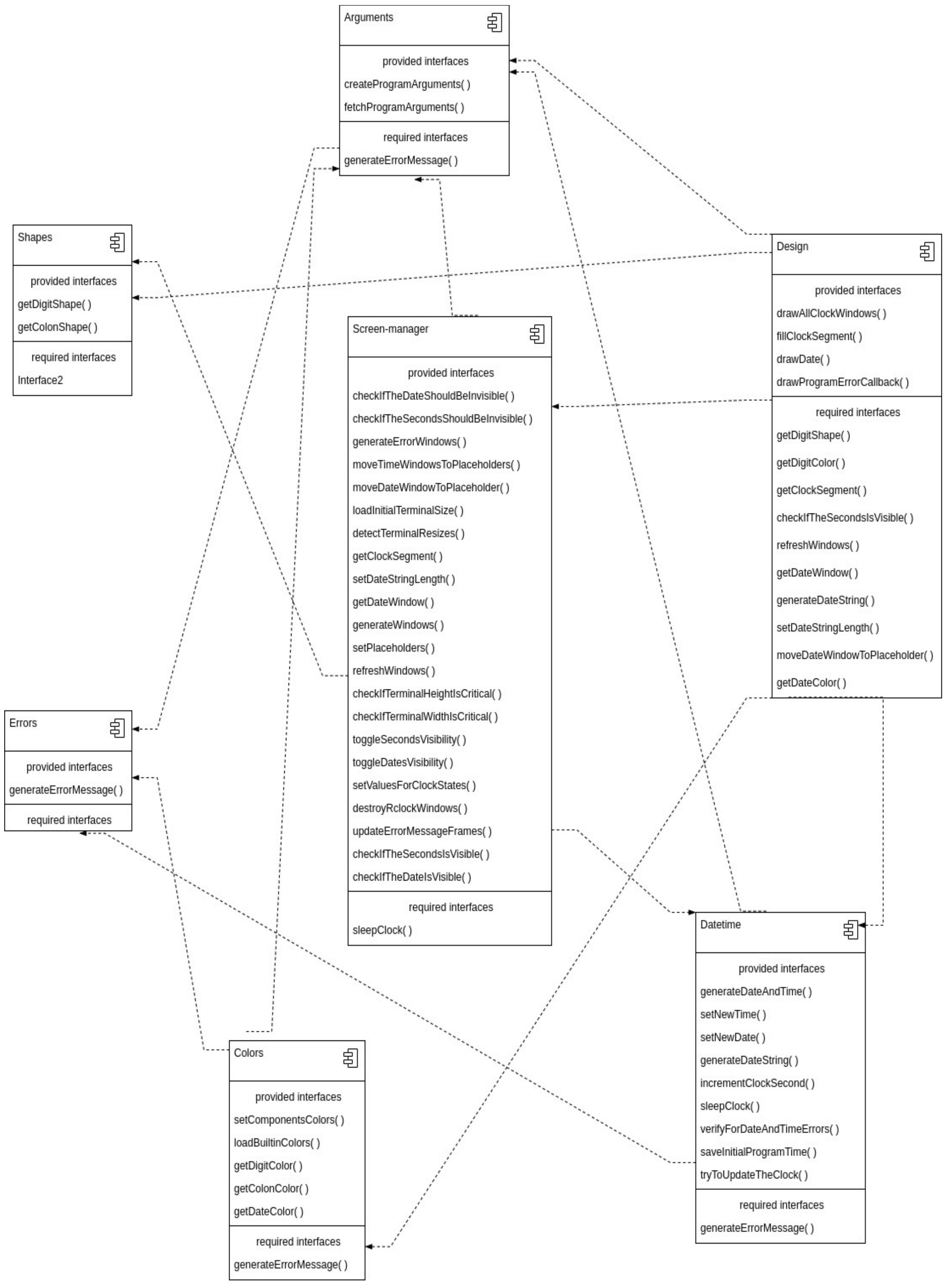
The colors.c is a module that will handle everything that involves colors, load built-in colors and get colors for each element on screen is done here.

3.2.2.6. arguments.c

The arguments.c is a module that will handle the user input through the command-line arguments, its job is to parse them and generate a struct that offers in different fields what each part of the software will use.

3.2.3. The relationship between modules

Plan how the modules will communicate among them is a important step as we are creating a software, with this, we can get a better picture of their behavior and help us to avoid circular dependencies. Here is the diagram that illustrates how they are being used.



3.2.4. How the project should be translated to a programming language

After listing the main parts of the software, the remaining work is just join everything to make the final software. The main structure of the program will be a loop that sleeps for 50 milliseconds, for each loop, a set of functions will run to keep the clock updated and the screen responsible. In this section will also be defined a pattern of letter case for a better understanding and collaboration among those developers who want to work on this code in the future.

3.2.4.1. The letter case of the project

- All variables shall be in camel case, that is, camel case that begins with lowercase
- All functions/procedures shall be in camel case, that is, camel case that begins with lowercase
- All new types shall be in upper camel case, that is, camel case that begins with uppercase
- All structs shall be in upper camel case, that is, camel case that begins with uppercase
- All file names shall be in lower kebab case, that is, lowercase words split by hyphens

3.2.5. How the tests should be performed

Test a software is a very important step on software development, and a software like the Rclock that has a high level of customization must be tested at the same level. All the tests will be performed inside the **tests/** directory, the first tests will be performed using unit testing, when a great part of the modules be ready for using, integration testing will be performed to make sure that the software will work as expected.