

# OneClockToRuleThemAll Requirements and Specifications

Sponsor

**Dr. Victor Hsu**  
**Oregon State University**  
**Department of Biochemistry and Biophysics**

Authors

**Tasman Thenell**  
**Tristan Hari**  
**Scott Metzsch**

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**Abstract:** This document outlines the requirements and specifications for our senior capstone project, "One Clock To Rule Them All." In the sections below we will give a better understanding of the overall idea of the project, as well as a more specific break down of what exactly will be done, how the product will perform, and what one could come to expect from a user experience of using the end product. We will also cover detailed technical information and ranges of operation for the device. Overall the clock in itself is a very simple device and fairly straightforward, however we will discuss the details here.

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# 1 Introduction

## 1.1 Purpose

Historically, the clock face has had one of two display modes, analog or digital. These formats have provided a solid mix between function and fashion, but there are many other possible ways of visually representing the concept of time. One creative idea worth exploring is timekeeping through words and letters. Although some examples of this already exist in the high end fashion market, such as QWLock or others, they are well outside the price range of an average consumer. The purpose of our project is to provide a similar product with much cheaper production.

## 1.2 Scope

The name of our product is tentatively “One Clock To Rule Them All”, or “The One Clock.” The One Clock’s function will be, simply, to tell time. However the functionality of it is defined as being able to creatively tell time through a grid of apparently random letters. Time will be displayed in forms such as “It is half past twelve” or “it is one fifty.” The user will be able to set the starting time using a button component on the clock. Something that may be assumed as a regular clock function that our clock will not do, is that this clock is not centered around being an alarm/scheduler device. We do not intend to have any sound components and thusly any alarm system will be mostly moot.

## 1.3 Definitions

- a) Time - The abstract concept that our machine is keeping track of and displaying to the user
- b) Real Time Clock - A real time clock module is the hardware component that tracks the passage of time regardless of the state of the rest of the system.
- c) RTC - Acronym for Real Time Clock module.
- d) Microcontroller - The brains of the clock. This module interfaces between the hardware components, the RTC, LEDs and buttons, and processes the logic for all clock functionality. This includes tasks like updating the display and processing user input from the buttons.
- e) Programmable LED - A Light Emitting Diode that has variable levels of brightness and color output. Each module is individually programmable in terms of brightness and color.
- f) LED - Acronym for Light Emitting Diode. Within this project, the term LED will always be used to refer to a programmable light emitting diode.
- g) Display - The LED lit letters of the clock face in a grid arrangement are collectively called the display. This term will be used to refer to the visual
- h) Software Library - The set of control software running on the microcontroller which drives all display output.
- i) User Interface - A set of buttons by which the user controls and interacts with the clock.
- j) BCD - Acronym for Binary Coded Decimal.
- k) Binary Coded Decimal - A method for encoding decimal numbers and information via binary.
- l) USB - Acronym for Universal Serial Bus.
- m) Universal Serial Bus - A communications medium by which the device is programmed and powered.

## 1.4 Overview

The following sections of this requirements document describe product specifications as follows. Section 2 explains the purpose, function, and form of the product in broad terms on a less technical level. Building on that foundation, Section 3 breaks the functional requirements describe in Section 2 into technical requirements and specifications. Both of the following sections are intended for conveying the entire functional scope of the Word Clock project but at different levels. Section 2 provides an overview of the project while Section 3 pertains to exact requirements which requires a more technical working knowledge of hardware and software design.

# 2 Overall Description

## 2.1 Product Perspective

The clock we are making will be completely self contained with a battery or wall plug being used to power the clock. There will be a microcontroller that is used to control the LEDs on the display and interface with the RTC in order to provide accurate timekeeping capabilities.

On the side of the clock there will be 4 buttons that will be used to set the time on the clock and change features. Each button provides a specific function depending on the software context. An example of this system when a basic menu is being manipulated would have two buttons providing up and down scrolling, one button to select an option or submenu, and the last button serving as a back or exit button.

The microcontroller will be the central piece of hardware in our clock and have the software for running it embedded into it. The RTC will be connected to the board through 6 ports and will be used to check the time periodically to verify that the time is still correct. The LEDs will also be connected to the board and the microcontroller will send data to the LEDs that tell them which LEDs to light up. Lastly the 4 buttons will be connected to the microcontroller to set time and access additional features added to the clock.

## 2.2 Product Functions

Expected functionality related to standard clock features is known at this time but other possible features have yet to be determined. A vague reference to these future items is listed as the last function but no requirements for this item is included in section 3.

- a) The main function of the clock will be to tell time through words displayed on the face of the clock. Examples of the output format include “it is a quarter past twelve”, “it is a quarter to five.”
- b) The clock shall provide a way for the user to set and edit alarms. While making an audible alarm isn’t planned, user programmable alarms indicated by the display flashing are expected functionality.
- c) Additional functionality includes the possibility of adding extra features to the clock such as color changes to tell the time of day, differences in brightness, and other features whose development is purely contingent on time constraints.

## 2.3 User Characteristics

Users of this product are expected to fall into two categories. While that might seem to over generalize things, users break down cleanly into two categories. The first is normal users who are just using this product as a clock. The second type of user is the poweruser who might want to tinker with the software and hardware of the clock in order to understand or expand upon it.

- a) A normal user is expected to be able to read, tell time and use a manual.

- b) Developers are expected to have the skills of a user as well as knowing the capabilities of the hardware interfaces and the microcontroller in addition to any skills necessary for software development.

## **2.4 Constraints**

The project needs to be meet a small set of physical and architectural constraints. These constraints center around the units ability to act like a traditional clock in a reasonable amount of space.

- a) The product must be accurate over the course of the year.
- b) The system needs to be compact enough to fit in a normal wall clock.
- c) Power shall be supplied via a conventional micro USB feed.

## **3 Specific Requirements**

### **3.1 External Interface**

A set of 4 buttons provide the only interface to the software. These buttons allow access to interacting with any available software menus. This is the only point of contact between the user and the software.

### **3.2 Functions**

The following items break down the general concepts of acting like a clock into individual components of functionality. Together these functions are the software side of how this product will be able to act like a clock.

- a) The system shall offer the user the ability to set the time via a physical interface.
- b) The system shall allow for setting, modification, and viewing of alarms.
- c) The system shall provide a visual indicator of an alarm going off but will not provide any auditory notification.
- d) The system shall recover from any series of inputs via the four button interface. Any input from other sources is considered unsupported and may result in undefined behavior.
- e) The system shall provide a menu option for switching output mode into BCD as well as a method for returning from BCD to the normal word output mode.
- f) The system shall update the time displayed every minute but the time in words shall be updated only every five minutes.
- g) The system shall provide a visual indicator for single minute increments of time.

### **3.3 Performance Requirements**

- a) The clock shall update the time being displayed within a second of the time in minutes changing.
- b) The clock shall not lose more than .432 seconds of accuracy per day.
- c) The system shall maintain this accuracy regardless of the presence of power for at least nine years, the lifespan of the RTC internal battery.

### **3.4 Physical Requirements**

- a) The system components, not including the clock housing, shall weigh no more than 5 pounds.
- b) The display shall be legible at a range of up to 10 feet for users with typical visual acuity, roughly equivalent to a 20/20 rating.
- c) The clock shall operate with the accuracy described in section 3.3.2 and 3.3.3 within the temperature range of 0 degrees to 85 degrees fahrenheit.
- d) The grid of letters used to display the time will be no smaller than 10 by 10 and no larger than 25 by 25 letters.
- e) The system shall be powered by a micro USB port.
- f) The system shall have four tactile buttons.

Victor Hsu

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Tristan Hari

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*Date*

Tasman Thenell

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Scott Metzsch

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