WordClock User Guide

Contents

WordClock User Guide 1/28/20 Version 2.5

Introduction

Word clocks have always been very popular. Most were designed with B7971 Nixie tubes. Prices for these tubes has increased to the point where the cost to purchase six, approaches one thousand dollars. WordClock-1 uses relatively inexpensive alphanumeric LED displays that will last a lifetime.

WordClock-1 includes an English library of over 9000 words that are randomly chosen and displayed every five seconds along with the time and date, at optional intervals. An English expletive file is included with words that are also randomly inserted and displayed. Three levels of expletives are available from mild to strong, displaying based on user defined settings. The library has been purged of derogatory references to race, religion, and sexual orientation.

Many additional libraries and languages are included, with over 30,000 additional words. Due to the limitation of the sixteen segment displays, words with extended characters are not included in the library. Word groups up to 64 characters long can be displayed, groups over six characters will automatically scroll the display.

A Proverbs library displays English Proverbs randomly at user settable frequencies.

Klingon is also included. It uses the English library so English words are transliterated. This means that anyone who can actually read Klingon will annunciate English words and numbers, or something close.

Additional libraries or partial libraries may also be included and will be added as submitted by users. Check the web site at www.angryelectrons.co for the status of each included library.

All files are stored in plain text, on a removable SD card. Words can be added, deleted, or edited in the word, expletive, and message files, using a text editor. New library bitmap fonts can be created and added, and messages can be localized for the default library. Words from up to five libraries can be displayed randomly at user specified intervals.

Additional features of WordClock include:

- Initial setup and configuration are accomplished using a web browser on a PC or mobile device.
- UTC offsets with 30 and 45 minute time differences are supported, for use anywhere in the world.
- Daylight Saving Time (DST) start and end times are supported.
- Connects to a GPS satellite receiver (not included), or open or WPS password protected Wi-Fi networks.

WordClock User Guide 1/28/20 Version 2.5

- Three override modes turn off or dim the display and backlight, optionally switching to time only based on weekdays, weekends, or both.
- Accuracy is approximately one second for NTP, better for GPS.
- Background RGB LED effects are available with a variety of patterns and options. A library indicator option will light the backlight behind LEDs 1-5 in green to indicate a word from *Library 1-5* of the Word file, and red for the Expletive file.
- Up to five libraries or word sets.
- Optional expletive file for each library with three levels, mild->medium->strong. A dedicated button quickly changes levels, and startup level is specified in settings.
- Ability to add and change words easily using a text editor.
- WordClock-1 display height is .8", and the display is readable from approximately 20 feet. WordClock-2 display height is 2.3". Both displays are extremely bright.
- Words or word groups can optionally be included on each row in the word file to a maximum of 64 characters, separated by the pipe symbol. The second word group will be displayed after the first word group. This can be used for any purpose including language learning, as long as both languages can be displayed using the same font file. Example language learning libraries are included, and a Proverbs library.

Quick Start

- Connect a 9-12v power supply. The required connector is 2.1mm in diameter, center positive. The clock is reverse voltage protected.

- AP will blink on the display, indicating access point mode.

- From a mobile device or pc, connect to the Wi-Fi network named *WordClock*.

- Enter 192.168.13.1 into the URL field of any web browser.

- The default time source is NTP. If using a GPS receiver, (not included), set the baud rate to correspond with the receiver, probably 9600 baud. Otherwise select the Wi-Fi network and enter the password.

- The default library set on startup or factory reset, is *Library 1*, English. This library must be present on the SD card until it is changed in setup.

- Change other settings as appropriate, referencing this manual.

- Press the *Save* button below the last field, to save selections and start WordClock.

- Library names will be displayed at startup, for all libraries that are enabled and have all required files present.

Operation

General

Words are randomly chosen from the word file on the SD card, and displayed every five seconds. Libraries are chosen based on parameters in the configuration settings.

Time and date can be displayed each minute, or several times each minute as specified in the settings.

Libraries

WordClock can display up to five libraries. Each library is stored in a folder on the SD card. The name given to each library is the folder name, and each file related to a given library uses the same file name, with an extension related to its function. Names can be no longer than eight characters. Spaces are not allowed. A maximum of 25 libraries will be recognized on each SD card, regardless of the number of libraries on the SD card. WordClock can use up to five libraries at a time.

Several library names end in a number. That number represents the maximum length of each word in that library. WordClock transitions between words that are equal to or fewer than the number of displays, without scrolling.

Library 1 is the default library. It must be present for WordClock to operate, and it must be entered in the *Library 1* field, in setup options. Only *Library 1* must have a message file, and each library must have a font file. Each available library is presented in a dropdown, up to 25. No validations are done during library selection.

The percentage of time that libraries 2-5 are mixed with the default library, is set in the *Settings* menu.

Library.wds

The word file name must use the extension .wds. The default library is initially set to English.wds. This can be changed in Settings.

Each word group within a file is on a separate row followed by a carriage return and line feed. A second word group separated by a pipe symbol (|) may be entered on the same row. The second word group will follow the first word group. Both word groups must use the same font file.

Library.fnt

Each library must have a font file included in the same folder.

Library.msg

A message file is also required, but only for the default, *Library 1*, because all messages are displayed using the default library. The default message file is English.msg. If another library is set as the default, *Library 1*, a message file must be created for that library if it does not exist.

Library.xpl

The expletive file is optional. Its file extension is *.xpl*. Each word is followed by the pipe symbol (|) and a level number from 1-3, in order from mild to medium to strong. The default level used when the clock is powered, is specified in *Settings*. The level can be quickly changed by pressing SW1.

Button functions

SW1 - Each short, single press cycles Expletive Mode between *Off→Mild→Medium→Strong*. The current mode is displayed as the button is pressed. The default mode when the clock is powered, is set in *Settings*. Expletive mode is not reset until the button is pressed, or the clock is restarted.

Each short, double press cycles Clock Mode between *60 Seconds->30 Seconds->15 Seconds->Always On->Off*. Clock Mode is changed with an *Override* setting, or when the clock is restarted.

SW2 – A single press activates sleep override. A double press puts WordClock in *Access Point* mode to change *Settings*. A double press while in AP mode, cancels AP mode, except after a factory reset. A triple press activates light sensor calibration mode.

Pressing SW2 while applying power puts WordClock in *Access Point* mode, and resets all settings to their factory defaults. After a factory reset, *English* must be preset on the SD card. Once the clock is started, the default library can be changed.

Messages

SD Card – The SD Card cannot be mounted. It may not be present, or it may be formatted incorrectly.

Font X – The font file for *Library X* entered in *Settings* is not present. X will be replaced with the library number from 1-5. All libraries must have font files.

Mesg 1 – The message file for *Library 1* cannot be found. Only the default library, *Library 1*, requires a message file because all messages are displayed from the default library.

Word X – The word file for *Library X* is not available on the SD card. X will be replaced with the library number from 1-5. All libraries must have word and font files.

Wi-Fi – While connecting to a Wi-Fi network, this message will be displayed.

WordClock User Guide 1/28/20 Version 2.5

NTP – This message indicates that the clock is connecting to an NTP time server, after establishing a Wi-Fi connection. It is displayed quickly or not at all.

GPS – While connecting to GPS, this message will be displayed. GPS connections take much longer to resolve than Wi-Fi and NTP connections, so this message may be displayed for a minute or more. If no connection is made after a period of time, check the light on the GPS module to confirm that it is connected to GPS satellites, and that the baud rates match.

AP – This message is displayed while WordClock is in Access Point mode, waiting for *Settings* to be saved.

Off→Mild→Medium→Strong – Displayed when SW1 is single pressed to change Expletive Mode. These messages are only displayed if there is at least one expletive file available in any of the five libraries.

60 Seconds->30 Seconds->15 Seconds->Always->Off – Displayed when SW1 is double pressed to change *Clock Mode*.

BAD – The software was illegally copied. It is a product copyrighted © 2019 by Mitchell Feig, and is exclusively distributed by OCEAN7 Watch Company, d/b/a Angry Electrons.

Bottom-Right Colon Blinks - The bottom-right colon blinks to indicate that Wi-Fi/NTP or GPS connectivity was lost. WordClock will continue to attempt to establish a connection until successful. This message can be disabled in *Settings*.

Override Modes 1-3

Three override modes can be set based on hourly on/off times. Several options are configurable within each range. For example, WordClock can be set to dim the display and show the time only with no background lighting, between 11:00PM and 7:00AM on weekdays. A second range can be set to dimly display words, and to display time every fifteen seconds on weekends only.

If override mode time ranges overlap, the range with the lowest number, has the highest priority.

Configuration settings

Access Point

A new WordClock will start in AP mode the first time it is powered. To start in AP mode after WordClock has been running, press SW2 two times. To start in AP mode and reset all settings to factory defaults, hold SW2 and apply power.

When AP is displayed, select the Wi-Fi network *WordClock* from a pc or mobile device. After a connection is indicated, enter 192.168.13.1 into the URL line of a web browser. The *Settings* options detailed below will be displayed. Press the Save button after settings are updated.

Do not use question mark, comma, or control characters in any *Settings*.

All hourly settings use 24 hour time regardless of the display setting.

- Access Point Name – The name of the access point that appears as the Wi-Fi network when connecting from a pc or mobile phone's browser. The default is WordClock-X, where X is the model.

- Network SSID – Available networks are displayed in a dropdown. Select the network to connect to if using NTP as the time source. Although SSIDs with spaces may be displayed, WordClock may fail to connect. No more than 25 characters are recognized.

- Password – Enter the password for the Wi-Fi network. Spaces within passwords, and trailing spaces, are not allowed. Maximum length is 25 characters.

- NTP Server – If using Wi-Fi to sync time, enter the name of the NTP server. This field defaults to pool.us.ntp.org.

- Library 1-5 – Select the library from the dropdown. To activate libraries 2-5, select the *Use Library* percentage below.

- NTP or GPS – Select the time reference. To use GPS, an optional GPS receiver must be connected to J4.

- Time Display – Select the desired option to display 12 or 24 hour time.

- Clock Mode – This sets how often and whether time is displayed each minute

- Date Display – This selects the date format, and whether to display the date after the time. If enabled, the date is only displayed at zero seconds. Clock only mode will disable date display.

- Display Brightness – Set the default display brightness for the alphanumeric display.

- Colon Display – Sets the flashing pattern for the colons when the time is displayed.

- Backlight Effect – Select from a variety of default color patterns for the background RGB LED lighting. *Show Library* will use the backlight behind LEDs 1-5 to indicate which library is being displayed. If the word is from the Word file, it will glow green. If it is from the Expletive file, it will glow red.

- Backlight Brightness – Set the default backlight RGB LED backlight brightness.

- Override Start Time 1-3 – Starts the override at the selected hour.

WordClock User Guide 1/28/20 Version 2.5

- Override End Time 1-3 – Ends the override at the selected hour.

- Override Days 1-3 – Activates override mode for All, Weekdays, or Weekends.

- Override Brightness 1-3 – Sets the brightness of the display when in override mode.

- Override Backlight Effect 1-3 – Sets the effect while in override mode.

- Override Backlight Brightness 1-3 – Sets the backlight brightness when in override mode.

- Override Clock Mode 1-3 – Sets the clock mode when in override mode.

- Period Override Time – When in *Override Mode*, a short press of SW2 will revert WordClock to its defaults. This sets the amount of time to temporarily cancel *Override Mode*.

- UTC Offset Hours – Sets the number of hours offset from UTC time.

- UTC Offset Minutes – Used for a few time zones worldwide.

- UTC Offset Direction – Sets the offset specified to + or -.

- DST Start Month – Sets the month that daylight savings time starts.

- DST Start Week – Sets the week of the month that daylight savings time starts.

- DST Start Day – Sets the day of the week that daylight savings time starts.

- DST Start Hour – Sets the hour of the day that daylight savings time starts.

- DST Offset – Sets the offset in hours for daylight savings time.

- DST Offset Direction – Sets the offset direction specified to + or -.

- STD Start Month – Sets the month that daylight savings time ends.

- STD Start Week – Sets the week that daylight savings time ends.

- STD Start Day – Sets the day that daylight savings time ends.

- STD Start Hour – Sets the hour that daylight savings time ends.

- Light Level Threshold – Sets the background light level threshold required to dim the display. Press SW2 three times to display the current threshold. The display will be active for 30 seconds.

- Light Level –Adjust – Adjusts the display to this light level setting when the Light Level Threshold is above the current light level.

- GPS Baud Rate – Sets the baud rate for the GPS receiver. The usual default setting for most receivers is 9600 baud.

- Expletive Level – Sets the default expletive level. This is the default level set when the clock starts. The level can be changed quickly by pressing SW1.

- Expletive Mix – Sets how often expletives are displayed in relation to the word file.

- Change Effect – Sets the change effect when words on display transition. Slides move from one edge to the opposite edge. Energize constructs and deconstructs each character randomly by segment. Only Slides are used for time and date. The last option randomly varies the effect.

- Use Library 2-5 – Sets how often each library is displayed in relation to the first, default library.

- Time and Date – Always use the *Library 1* font file, or use the currently selected library. The first option will prevent the time and date from being displayed using an alternate font such as Klingon.

- No time source indicator – When enabled, if the Wi-Fi/NTP or GPS connection is lost, the LEDs behind the first display will be off..

- Scroll All Words – 'No' uses change effects between words equal to or shorter than the number of display characters. 'Yes' scrolls all words regardless of the display size.

Library Files

Check the web site at www.angryelectrons.co for the status of each library included on the SD card. It is often updated, and the latest libraries can be downloaded as a zip file.
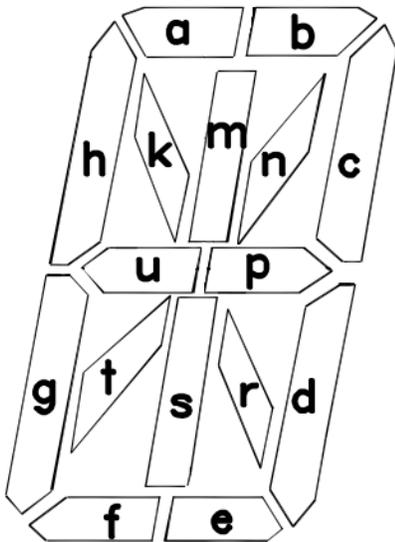
Additional complete or partial libraries may be included on the SD card as they are added and submitted.

Font

Fonts are stored in text files. The file name for each font file, from the root of the SD card, is */Library/Library.fnt*. Each line in the plain text file begins with 16 *0s* and *1s* representing each segment in the diagram and order below.

Any ASCII character from 32-255 can be represented in the font file within the limitations imposed by the 16 segment display, in the following order:

WordClock User Guide 1/28/20 Version 2.5

u t s r p n m k h g f e d c b a

Segments will be off if *0* is in that segment's position, and on with *1*. Comments can be entered after the 16th character on each row. Any text editor that does not add control characters can be used to edit the file, including Notepad on Windows. Notepad++ is a free text editor that offers many additional features. Below is an example from the English font file on the SD card. Its path is */English/English.fnt*.

1000100011001111 A

0010101000111111 B

0000000011110011 C

Following the 'A' font entry as an example, the segments that will be on include *uphgdcba*.

The row position each character is entered on in the file corresponds to its ASCII value starting at 32, which is a *space*. The font loader supports up to 223 rows (255 – 32).

Word

The word file is located at */Library/Library.wrd*. One or two word groups can be included for a total of 64 characters, separated by a pipe symbol (|). Commas are allowed within word groups.

If two word groups are included, the second word group is displayed after the first word group. A group longer than six characters will scroll the display. The scroll speed is controlled by the size of the group, over five seconds. Long word groups will scroll more quickly. For long

groups, insert a pipe symbol to break the group in two, then each group will scroll over five seconds. See the *Proverbs* files for examples.

Message

The message file is located at */Library/Library.msg*. Each message file requires the following entries, in this exact order:

Wi-Fi

GPS

NTP

AP

Off

Mild

Medium

Strong

60 Sec

30 Sec

15 Sec

Always

Off

Only *Library 1*, the default library, requires a message file, and only the default message file is used to display messages.

Expletive

The expletive file is optional. It is located at */Library/Library.xpl*. The structure of each row is word group, pipe symbol, level from 1-3. The levels correspond to mild, medium, and strong. Spaces between *word*, *pipe*, and *level* are not allowed, but spaces and commas can be used within each word. Higher levels also include lower levels, so level 3 will also include levels 1 and 2. Word groups can be up to 64 characters in length. An example follows:

Word Group Up to 64 characters|1

Word4|2

Wo rd3|1

Wo,rd2|3

Each expletive file has a limit of 125 word groups (rows), and each row can be up to 64 characters long. Rows over six characters will scroll over five seconds. Consider that the scroll speed will be extremely fast for long rows. Words do not have to be in any specific order, but keeping them alphabetized makes editing easier.

Software Updates

Occasional software updates may be provided to improve performance and/or add new features. Carefully follow these instructions to update the software.

Disconnect power from the clock. Connect the microcontroller board to a PC using a cable with a micro USB connector. In Device Manager, note the COM port.

DO NOT connect the USB cable while the board is powered!

The microcontroller board can be removed from the main board when updating the firmware.

Download and install the Flash Download Tools (ESP8266 & ESP32) from Espressif. A link is provided on the web site at AngryElectrons.co.

Select *ESP32 Download Tool* from the menu.

Select *SPIDownload* tab and enter the following settings:

Download Path Config: Select the file provided by email or the web site by clicking on the box with three dots, on the first line. After "@", enter address 0x00010000 (four zeros after the one). Check the box to the left of the file name.

DO NOT CLICK *ERASE* or the microcontroller WILL have to be returned for reprogramming.

DO NOT CHECK ANY OTHER BOX IN THE LEFT COLUMN. IF THEY ARE CHECKED BY DEFAULT, UNCHECK THEM.

Additional Settings
Crystal Freq:40M
SPI SPEED: 40MHz
SPI MODE: QIO
FLASH SIZE: 32Mbit
COM: Port: Enter the port noted in the Device Manager.
BAUD: Select 921600. If the update fails, try a slower baud rate.

DO NOT SET OR CHANGE ANY OTHER SETTINGS. REVIEW TO MAKE SURE ALL SETTINGS ARE CORRECT, ESPECIALLY THE ADDRESS NUMBER AFTER "@." IF INCORRECT SETTINGS ARE FLASHED, THE MICROCONTROLLER MAY HAVE TO BE RETURNED FOR REPROGRAMMING.

Click *START*. When finished, disconnect the USB cable and disconnect power from the clock for a few seconds.

Notice

This software and hardware product is Copyright (C) 2019 by Mitchell Feig. It is exclusively distributed by OCEAN7 Watch Company d/b/a Angry Electrons. All Rights Reserved.