

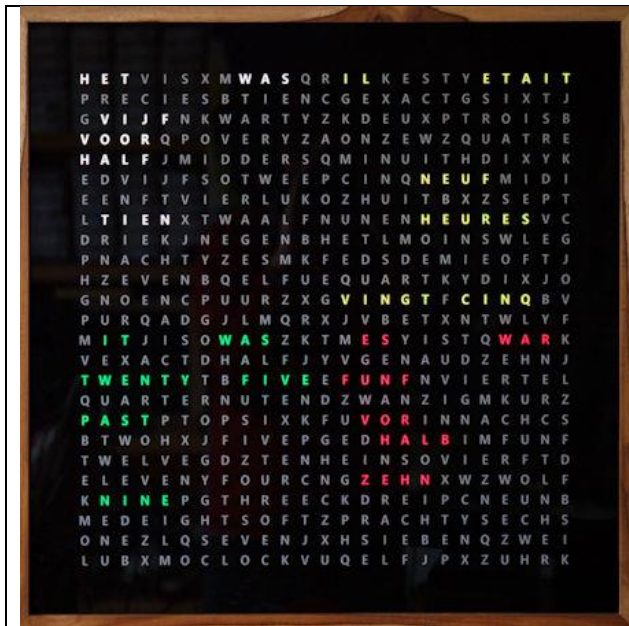
Arduino ESP32-Nano word clock

A clock that displays time in words in the languages Dutch, English, French and German in a large 4-language clock or as a single language clock.

The Arduino ESP32 Nano is used to drive the clock.

Time is synchronized with the Network Time Protocol (NTP) from the internet.

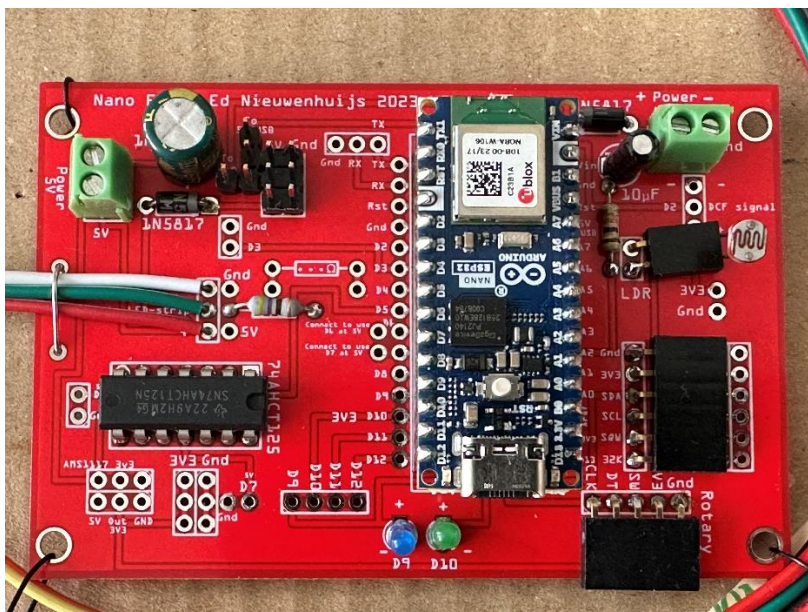
Settings can be controlled with a webpage, a PC or a Bluetooth Low Energy (BLE) serial terminal app installed on a phone, PC or tablet.



4-language clock



Dutch language clock



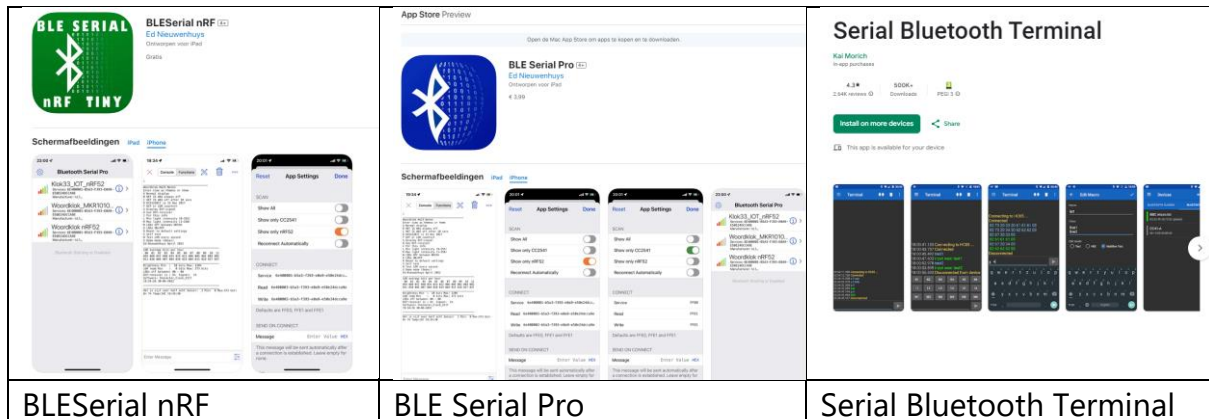
Arduino ESP32 Nano on the PCB inside the clock.

Before starting

The clock receives time from the internet if a DS3231 time module is not used. Therefore the name of the WIFI station and its password must be entered to be able to connect to a WIFI router.

The name of the WIFI-station and password has to be entered once. These credentials will be stored in memory of the microprocessor.

To make life easy it is preferred to use a phone or tablet and a Bluetooth communication app to enter the WIFI credentials into the clock.



- Download a Bluetooth UART serial terminal app on your phone, PC, or tablet.
For IOS: BLE Serial Pro or BLESerial nRF.
For Android: Serial Bluetooth Terminal.

Installations

To connect to a WIFI network a SSID (WIFI name) and password must be entered.

There are a few methods:

Connect the MCU in the clock with a micro USB serial cable to a PC and use a serial terminal.

Use a BLE serial terminal app on a phone or tablet for connection.

For a PC the app [Termite](#) is fine as serial terminal.

For IOS use: **BLE Serial Pro** or **BLESerial nRF**.

For Android use: **Serial Bluetooth terminal**.

Bluetooth Low Energy (BLE) can use two types of protocol CC25nn or nRF52nn where nn is a specific number. This clock uses nRF52 from the company Nordic.

- Start the app and start a connection with the clock. Some apps automatically start with a connection window but for some a connection symbol must be pressed. You will most probably find one station to select from.

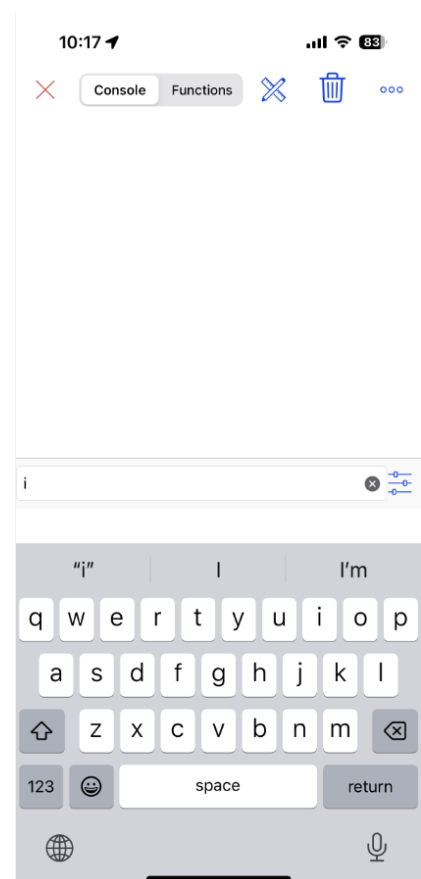
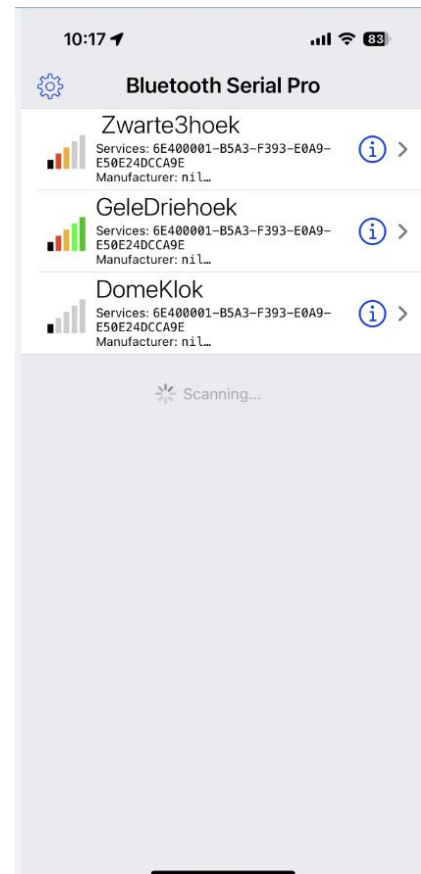
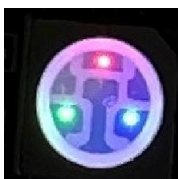
- Select the clock in the list.

- The app will display a window and a line where commands can be entered and send to the clock.

- Sending the letter l or i for information will display the menu followed with the actual settings of several preferences.

In the clock there is a LED that will have a red dot lighted when the program is running.

A green dot will turn on when there is a WIFI connection. When there is a Bluetooth connection a blue dot in the LED will light.



In both cases **send the letter I of Information and the menu shows up.**

Enter the first letter of the setting you want to changes followed with a code.

Some entries just toggle On and Off. Like the W to set WIFI Off or On.

To change the SSID and password:

Send the letter **A** or **a** followed with the WIFI station name.

Amy-ssid and send this command. Eg AFRITZ!Box01 or aFRITZ!Box01. Starting with an upper or lower case character is an identical instruction in the command string Then the letter B followed with the password.

Bmypassword and send the password.

Cbroadcastname will change to name displayed in the Bluetooth connection list. Something like: cMyClock

If the length of the SSID and/or password is less then 5 characters the WIFI will be turned off automatically to avoid connection errors.

Use a length of minimal 8 characters for SSID and password. Check in the menu (third row from the bottom) if WIFI and NTP are on.

Enter @ to restart the MCU. It will restart and connections will be made.

Sometimes a second or third reset must be given to get the clock connected to WIFI. If connection still fails check the SSID name and the entered password. (send the letter b, an easter egg)

If WIFI is connected the LED on the MCU will turn on a green dot.

A SSID B Password C BLE beacon name
D Date (D15012021) T Time (T132145)
E Timezone (E<-02>2 or E<+01>-1)
Make own colour of: (Hex RRGGBB)
I To print this Info menu
K LDR reads/sec toggle On/Off
L L0 = NL, L1 = UK, L2 = DE
L3 = FR, L4 = Wheel
N Display off between Nhhhh (N2208)
O Display toggle On/Off
P Status LED toggle On/Off
Q Display colour choice (Q0-7)
Q0 Yellow Q1 hourly
Q2 White Q3 All Own
Q4 Own Q5 Wheel
Q6 Digital Q7 Analog display
R Reset settings @ = Reset MCU
--Light intensity settings (1-250)--
S=Slope V=Min U=Max (S80 V5 U200)
W=WIFI X=NTP& Y=BLE Z=Fast BLE
Ed Nieuwenhuys May 2024

Display off between: 00h - 00h
Display choice: Yellow
Slope: 80 Min: 5 Max: 255
SSID: FRITZ!BoxEd
BLE name: ESP32Nano
IP-address: 192.168.178.106 (/update)
Timezone:CET-1CEST,M3.5.0,M10.5.0/3
WIFI=On NTP=On BLE=On FastBLE=Off
Language choice: Rotate language
Software: ESP32Arduino_WordClockV015.ino
02/05/2024 21:06:27

Menu displayed in serial output.

Default the clock is set to Amsterdam time. A reset with option R in the menu will restire this time zone to Amsterdam again.

To set a different time zone send the time zone string between the quotes prefixed with the character E or e.

At the bottom of this manual many timezones are printed.

For example; if you live in Australia/Sydney send the string, eAEST-10AEDT,M10.1.0,M4.1.0/3.

The clock will use the Daylight saving time (DST) when connected to an NTP server but not when using the DS3231 time module

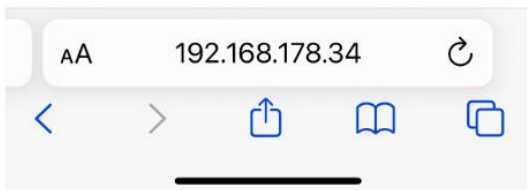
15:58 67

ESP32-Nano Word Clock

Enter time as: hhmmss (132145)

A SSID **B** Password **C** BLE beacon
D Date (D15012021) **T** Time (T132145)
E Set Timezone E<-02>2 or E<+01>-1
L Language **L0** NL **L1** UK
L2 DE **L3** FR **L4** Wheel
N Display off between Nhhhh (N2208)
O Display On/Off
P Own colour design (0-F) (P00FF00)
Q Display colour choice (Q0-Q6)
Q0 Yellow **Q1** Hourly **Q2** White
Q3 All Own **Q4** Own **Q5** Wheel
Q6 Digital **Q7** Analog -
R Reset settings @ Restart MCU
W WIFI On/Off **X** NTP &Requary
Y BLE On/Off **Z** Fast BLE

Send



HTML page on iPhone

```
Termite 3.4 (by CompuPhase)

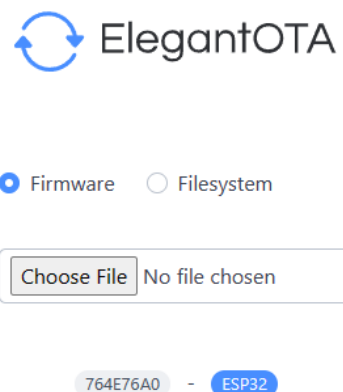
A SSID B Password C BLE beacon name
D Date (D15012021) T Time (T132145)
E Timezone (E<-02>2 or E<+01>-1)
  Make own colour of: (Hex RRGGBB)
F Font  G Dimmed font H Bkgnd
I To print this Info menu
K LDR reads/sec toggle On/Off
L L0 = NL, L1 = UK, L2 = DE
  L3 = FR, L4 = Wheel
N Display off between Nhhhh (N2208)
O Display toggle On/Off
P Status LED toggle On/Off
Q Display colour choice (Q0-7)
  Q0 Yellow  Q1 hourly
  Q2 White   Q3 All Own
  Q4 Own     Q5 Wheel
  Q6 Digital Q7 Analog display
R Reset settings @ = Reset MCU
--Light intensity settings (1-250)--
S=Slope V=Min  U=Max  (S80 V5 U200)
W=WIFI  X=NTP& Y=BLE  Z=Fast BLE
Ed Nieuwenhuys Aug 2023

Display off between: 00h - 00h
Display choice: Yellow
Slope: 80      Min: 5      Max: 255
SSID: FRITZ!BoxEd
BLE name: PaarseS3N8R2
IP-address: 192.168.178.106 (/update)
Timezone:CET-1CEST,M3.5.0,M10.5.0/3
WIFI=On NTP=On BLE=On FastBLE=Off
Language choice: Rotate language
Software: ESP32C3S3_WordClockV024.ino
00/01/1900 00:00:00
```

Termite Terminal from a PC

Upgrading software

Software can be upgraded over the air (OTA) by opening a web browser and entering the IP-address of the clock followed with /update.
 For example: 192.168.178.78/update.
 Choose firmware and click on Choose File.
 Choose the appropriate bin file.



Control and settings of the clock

As mentioned before the clock can be controlled with the WIFI webpage or BLE UART terminal app.

When the clock is connected to WIFI it has received an IP-address from the router it is connected to.

The IP-address is printed in the menu.

As a last resort the IP-address can be found in your WIFI router.

To start the menu in a web page the IP-address numbers and dots (for example: 192.168.178.77) must be entered in the web browser of your mobile or PC where you type your internet addresses (URL).

Or with a Bluetooth connection:

Open the BLE terminal app.

Look for the clock to connect to and connect.

Unfortunately some apps can not read strings longer than 20 characters and you will see the strings truncated or garbled.

If you see a garbled menu enter and send the character 'Z' to select the slower transmission mode.

If transmission is too garbled and it is impossible to send the character Z try the web page to send the character Z.

A third method is to use an iPhone, iPad or iMac with the free BLE nRF app.

If all fails you have to connect the MCU inside the clock with a micro USB cable to a PC and use a serial terminal app to send a Z.

Regulating the light intensity of the display

In the menu light intensity of the display can be controlled with three parameters:

--Light intensity settings (1-250)--
S=Slope V=Min U=Max (S80 V5 U200)

The default values are between the ().

S How fast the brightness reaches maximum brightness.

V How bright the display is in complete darkness.

U the maximum brightness of the display.

In the bottom half of the menu the stored values are displayed

Slope: 80 Min: 5 Max: 255

~~The clock reacts on light with its LDR (light dependent resistor).~~

There is no LDR (used) in the watch.

The watch can be set to L100



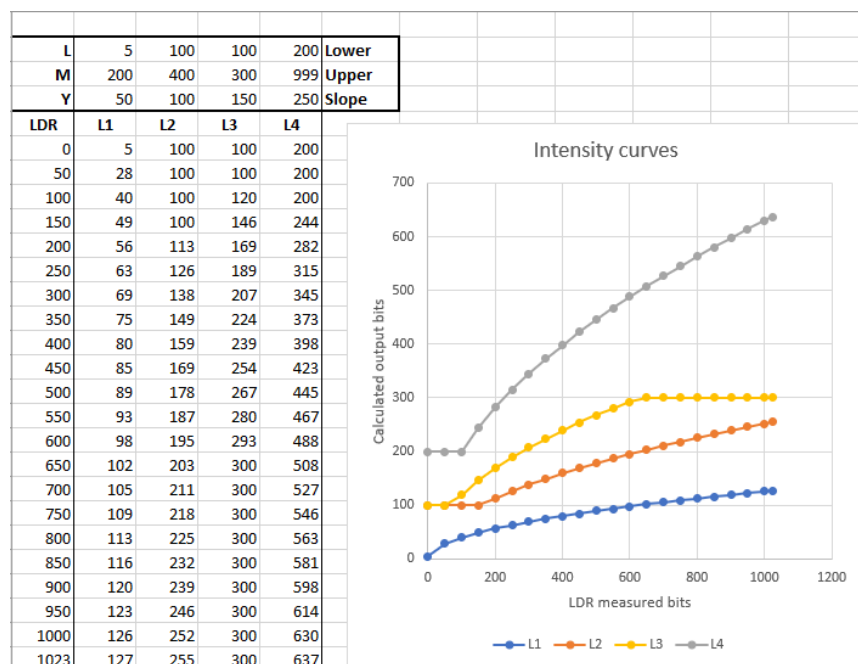
When it gets dark the display does not turn off completely but will stay dimmed at a minimum value.

With the parameter V the lowest brightness can be controlled. With a value between 0 and 255 this brightness can be set.

V5 is the default value.

The maximum brightness of the display is controlled with the parameter U. Also a value between 0 and 255.

With parameter S the slope can be controlled how fast maximum brightness is achieved.



Settings are set by entering the first character of a command following by parameters if necessary.

For example:

To set the colours of the words in the clock to white enter: Q2

To shown random all four languages every minute send L4. (This will not function in a single language clock)

Turn off WIFI by sending a W.

Restart the clock with the letter @.

Reset to default setting by send R.

15:58

ESP32-Nano Word Clock

Enter time as: hhmmss (132145)

A SSID

B Password

C BLE beacon

D Date (D15012021)

T Time (T132145)

E Set Timezone

E<-02>2 or E<+01>-1

L Language

L0 NL

L1 UK

L2 DE

L3 FR

L4 Wheel

N Display off between Nhhhh (N2208)

O Display On/Off

P Own colour design (0-F) (P00FF00)

Q Display colour choice (Q0-Q6)

Q0 Yellow

Q1 Hourly

Q2 White

Q3 All Own

Q4 Own

Q5 Wheel

Q6 Digital

Q7 Analog

-

R Reset settings

@ Restart MCU

W WIFI

On/Off

X NTP &Requary

Y BLE

On/Off

Z Fast BLE

Send

15:59

Console

Functions

i

A SSID B Password C BLE beacon name

D Date (D15012021) T Time (T132145)

E Timezone (E<-02>2 or E<+01>-1)

Make own colour of: (Hex RRGGBB)

I To print this Info menu

K LDR reads/sec toggle On/Off

L L0 = NL, L1 = UK, L2 = DE

L3 = FR, L4 = Wheel

N Display off between Nhhhh (N2208)

O Display toggle On/Off

P Status LED toggle On/Off

Q Display colour choice (Q0-7)

Q0 Yellow Q1 hourly

Q2 White Q3 All Own

Q4 Own Q5 Wheel

Q6 Digital Q7 Analog display

R Reset settings @ = Reset MCU

--Light intensity settings (1-250)--

S=Slope V=Min U=Max (S80 V5 U200)

W=WIFI X=NTP& Y=BLE Z=Fast BLE

Ed Nieuwenhuys April 2024

Display off between: 23h - 08h

Display choice: Yellow

Slope: 20 Min: 5 Max: 255

SSID: FRITZ!BoxEd

BLE name: NanoESP32Clock

IP-address: 192.168.178.34 (/update)

Timezone: CET-1CEST,M3.5.0,M10.5.0/3

WIFI=0n NTP=0n BLE=0n FastBLE=0n




Language choice: DE

Software: ESP32Arduino_WordClockV015.ino


05/05/2024 15:58:57

Het is vier uur M1 M2 M3 M4 05/05/2024 15:59:00 LDR: 28 (26- 28) 6% 222717 l/s 15:59:00

AA 192.168.178.34

< >   

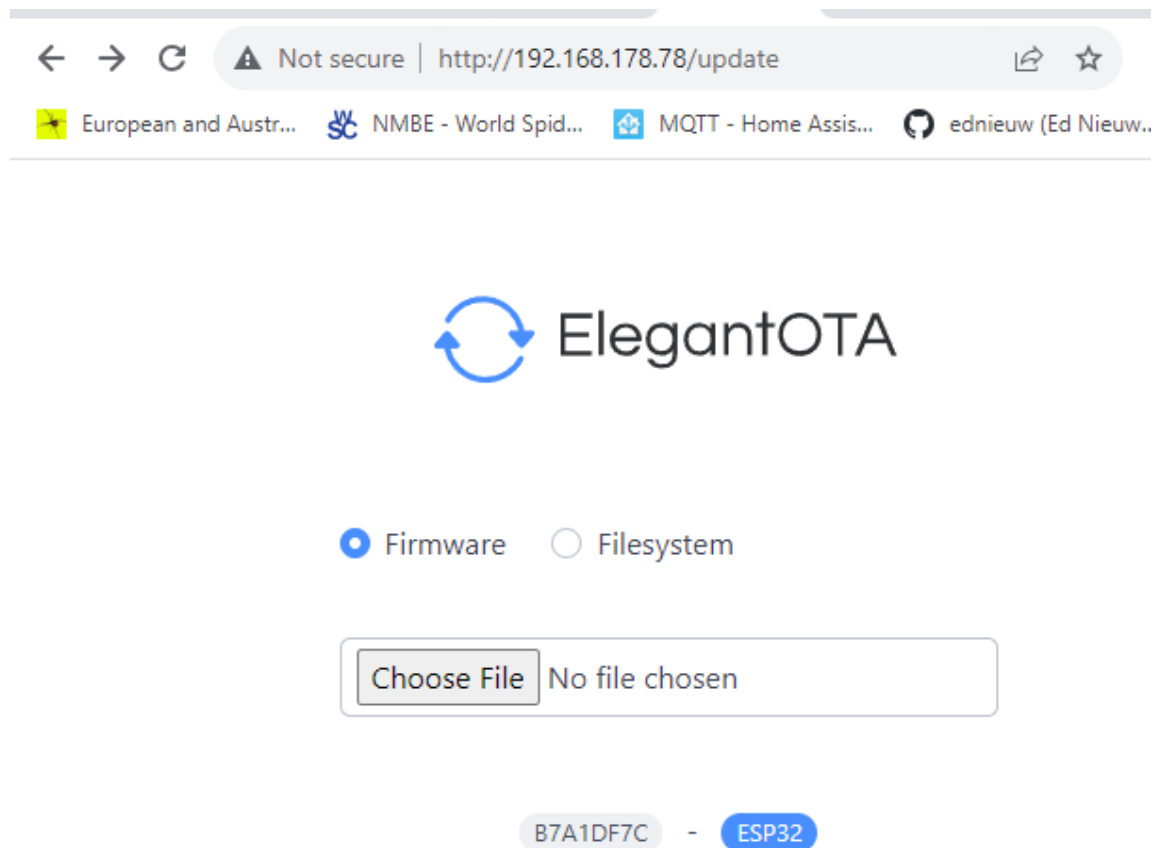
Enter Message



HTML page

BLE menu

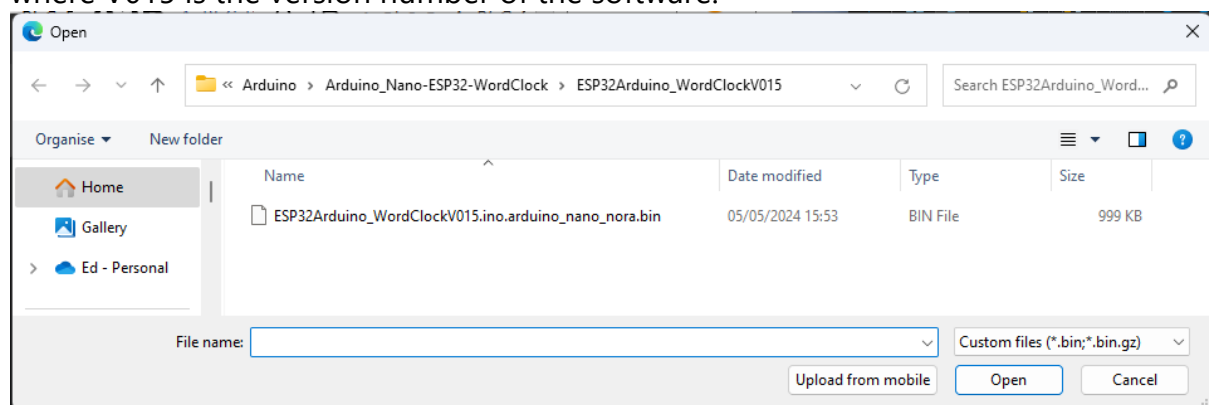
Updating the software

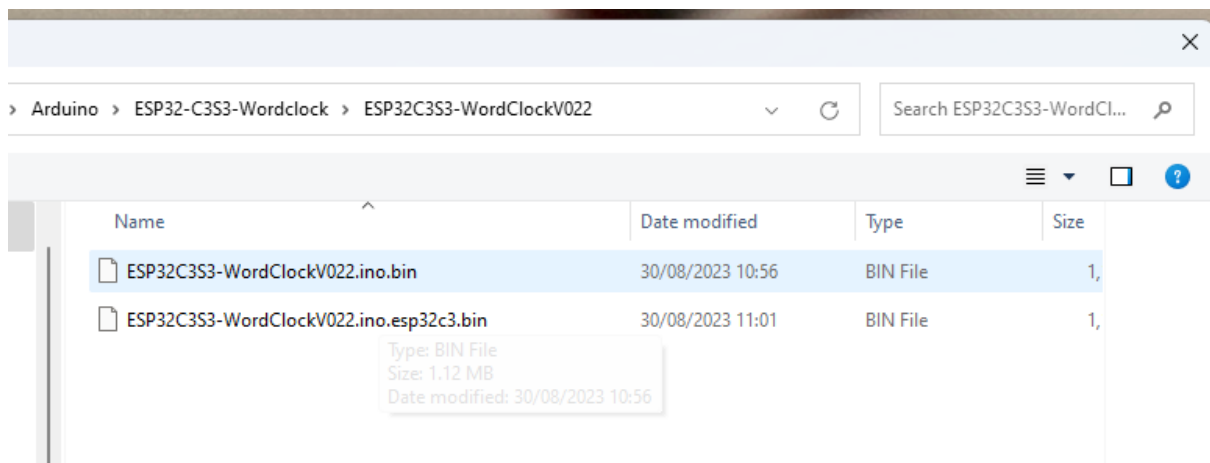


The software can be updated 'Over The Air' when the clock is connected to WIFI. You can find the IP-address in the menu or in the digital display mode menu option Q6.

Enter the IP-address of the clock followed with /update
Something like this : 192.168.178.78/update

'Choose File' in the menu and select the bin file to update.
Something like: ESP32Arduino_WordClockV015.ino.arduino_nano_nora.bin
where V015 is the version number of the software.





Detailed description

With the menu many preferences can be set. These preferences are stored on a SD-card or in the ESP32-S3 storage space.

Enter the first character in the menu of the item to be changed followed with the parameter.

There is no difference between upper or lower case. Both are OK.

A SSID B Password C BLE beacon name

Change the name of the SSID of the router to be connected to.

For example: aFRITZ!BoxEd or AFRITZ!BoxEd.

Then enter the password. For example: BSecret_password.

Restart the clock by sending @.

Entering a single 'b' will show the used password. This 'Easter egg' can be used to check if a valid password was entered.

D Set Date and T Set Time

If you are not connected to WIFI you have to set time and date by hand.

For example enter: D06112022 to set the date to 6 November 2022.

Enter for example T132145 (or 132145 , or t132145) to set the time to 45 seconds and 21 minute past one o'clock.

E Set Timezone E<-02>2 or E<+01>-1

At the bottom of this page you can find the time zones used in 2022.

It is a rather complicated string and it is therefore wise to copy it.

Let's pick one if you happen to live here: Antarctica/Troll,"<+00>0<+02>-2,M3.5.0/1,M10.5.0/3"

Copy the string between the " "s and send it with starting with an 'E' or 'e' in front.

E<+00>0<+02>-2,M3.5.0/1,M10.5.0/3

~~Make own colour of: (Hex RRGGBB)~~

~~F Font G Dimmed font H Bkgrnd~~

~~You can set the colours of the highlighted and dimmed characters and the background.~~

~~The format to be entered is hexadecimal. 0123456789ABCDEF are the characters that can be used. The command is 2 digits for Red followed with two for Green and ending with two digits for Blue.~~

~~To colour the characters intense red enter FF0000 prefixed with the letter F.~~

~~To set the background to intense blue enter: H0000FF~~

~~To set the dimmed character to dark grey enter for example: G191919.~~

~~You get grey if red, green and blue has the same intensity.~~

I To print this Info menu

Print the menu to Bluetooth and the serial monitor connected with an USB-cable.

J Toggle to use the DS3231 module time

Sending 'J' will toggle the use of an optional DS3231 time module ON and OFF.

If the clock does not has an internet connection time will probably drift undesirably quick. Installing a DS3231 time module will reduce the drift to a few seconds per year. Time can be entered with option T and D in the menu.

K Reads/sec toggle On/Off

Entering a K toggles printing of the LDR reading of the measured light intensity.

It also shows how many times the processor loops through the program and checks its tasks to run the clock.

L L0 = NL, L1 = UK, L2 = DE, L3 = FR, L4 = Wheel

In a 4-language clock you can choose between four languages to display or show them randomly every minute. This will not work with a single language clock.

N Display off between Nhhhh (N2208)

With N2208 the display will be turned off between 22:00 and 8:00.

O Display toggle On/Off

O toggle the display off and on.

P Status LEDs toggle On/Off

P toggle the status LEDs on the MCU off and on.

Q Display colour choice (Q0-6)

Q0 Yellow Q1 hourly Q2 White Q3 All Own Q4 Own Q5 Wheel Q6 Digital display

Q0 will show the time with yellow words.

Q1 will show every hour another colour.

Q2 shows all the texts white.

Q3 and Q4 uses you own defined colours.

Q5 will follow rainbow colours every minute.

Q6 is the digital display with the IP-address and date until seconds are 00.

Q7 is the analogue clock

R Reset settings

R will set all preferences to default settings, it also clears the SSID and password.

--Light intensity settings (1-250)--

S=Slope V=Min U=Max (S80 V5 U200)

The

! = Show NTP, RTC and DS3231 time

! will display the NTP, RTC and DS3231 time as they are stored in the clock in the clock. The DS3231 time module must be installed and being used to show a realistic time.

Same as & option but this option will not get the time from the internet NTP server

@ = Reset MCU

@ will restart the MCU. This is handy when the SSID, et cetera are changed and the program must be restarted. Settings will not be deleted.

= Selftest

Sending a # will start the clock self test. This is convenient to check if all the words in the clock are functioning.

@ will restart the MCU. This is handy when the SSID, et cetera are changed and the program must be restarted. Settings will not be deleted.

& = Get and stores NTP time in RTC and DS3231 time

& will get the NTP time immediately from the internet and stores it in the RTC clocks. This option is convenient to force the clock to get the proper NTP time.

In other cases the program will check the time running in the clock and on the NTP server so now and then and update the RTC clocks.

The DS3231 time module must be installed and being used to show a realistic time.

W=WIFI, X=NTP&, Y=BLE

Toggle WIFI, NTP on and off.

Enter the character will toggle it on or off.

At the bottom of the menu the stated is printed.

```
Display off: 00h - 00h
Display choice: Yellow
      SSID: FRITZ!BoxEd
      BLE name: ESPWordClock
      IP-address: 192.168.178.78
Timezone:CET-1CEST,M3.5.0,M10.5.0/3
WIFI=On NTP=On BLE=On FastBLE=On
Language choice: Rotate language
```

Sending a & will start a query from the time server.

Z Fast BLE

The BLE UART protocol sends default packets 20 bytes long. Between every packet there is a delay of 50 msec.

The IOS BLEserial app, and maybe others too, is able to receive packets of 80 bytes or more before characters are missed. This makes the menu appears faster.

Option Z toggles between the long and short packages.

@[Ed Nieuwenhuys](#), May2024