WiFi-LED-Clock

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1   Description

You have in your hands one of the most unique clocks on the market today. With it's classic, ticking, analogue clockwork and futuristic, silent, colorful, digital Light Emitting Diodes it surely would give your kitchen an eyecatcher people will talk about.

Don't use it in your bedroom though, its ticking is too loud and the lights will interrupt a good nights sleep. It could, however, double as a nightlight in the corridor between your bedroom and the bathroom.

We removed the need for batteries from this cheap IKEA clock. Which, by the way, isn't sold anymore by IKEA, but old stock is already sold at over ten times the old price on the market. You see, you've got a real collectors item here.

This clock comes with a 5 volt power supply to drive both the LEDs and the clock itself. It needs to connect to your WiFi network to get the time from a time server, so that the light patterns change according to the time of day. Some modes even dim the light at night. It is important to note here that the analog clockwork is not set digitally, you will need to do that manually. Also, the digital part is programmed to follow the timezone "Europe/Berlin" according to the rules active in 2017. If germany ever moves to abolish daylight savings time, this clock needs to be reprogrammed.

2   Setting it up

The power supply goes into a wall socket. Duh.

After the clock is powered on, it checks whether the stored WiFi credentials are still valid. As long as WiFi is not connected, the clock shows a solid red.

If this is not the case, it goes into access point mode, opening a WiFi with the name "Clock-Setup". Use your smartphone to connect to it. You should be presented with a dialog to connect to the network, like when you try to access a public WiFi and first have to accept the Allgemeine Geschäftsbedingungen. But there is no legal mumbo-jumbo to accept; instead, you could scan for your WiFi network and enter the pre-shared key (also known as "PSK" or "WiFi password").

If this for some reason does not work, try to set up the WiFi connection on your phone or laptop using the following data:

SSID	ClockSetup
Static IPv4 address	192.168.4.4
Subnet mask	255.255.255.0
Gateway	192.168.4.1

Then, point your web browser at http://192.168.4.1/, enter the credentials of your WiFi network and you're good to go.

Note that the clock will open that setup portal iff

1. it is powered on (or the chip is resetted)

2. and it cannot connect to the WiFi network previously configured.

As soon as the WiFi is successfully connected, the clock shows a solid blue. When it successfully resolved the IP address of a time server, it displays a solid green until the time server answers with the current time. Then the clock enters the default mode (see section 4).

You also will need to set the clock hands position using the dial on the backside of the clockwork. It is not advisable to try and synchronize the seconds hand with the digital LED display, because they will likely to be out of whack after a few weeks ... and anyway, the seconds are

hardly noticeable in the LED display, unless you know that red corresponds to zero in the HSV color model.

But if you achieve that, we applaud you!

3   Hang it up!

We included a hook and two nails (in case you hit the first nail wrong) to hang the clock up on your wall. We trust you to find a good spot for it and we also trust that you check the wall for hidden cables and pipes before not hitting yourself on your own fingers with a hammer. Which, by the way, you have to provide. Because we don't. Sorry.

You might notice that it might wobble a bit on the wall. This is partly intentional. You see, there is a button on the backside to switch modes and its position is determined in a way that you are able to press the front of the clock to push said button against the wall and thereby switching modes.

However, you may turn the fake battery the button is resting on by a few degrees to let the button sink more into the case. This might mean that you'd have to take the clock off the wall to switch modes. Your choice.

4   Mode setting

As we already told you in section 3 how to press the mode button, you might be curious about its function. You see, no customer is alike, and we strive to accomodate a wide range of tastes. But, as we like rainbows, all modes are somehow connected to rainbows. Sorry if that does not fit your taste. Try mode 10 or 11, they feature the least noticeable rainbow.

Okay, by pressing the button, you choose the next mode. One of the twelve LEDs lights up white for a moment to show you which mode is currently active.

After powering on, mode 0 is active. Sorry, I mean mode 12. It's mode 12 because of the 12-hour clock system. And simultaneously 0, because of the 24-hour system. Does that even make sense what I'm talking here? Anyway, it's 12, because the top center LED is assigned to it

when choosing modes. Also, it's 0, because the LEDs are controlled internally using a modulo 12 ring.

0/12 Medium bright rainbow ticking with the seconds around the clock, hour and minute hands highlighted with red and blue, brightness dimming at night.

1 Medium bright rainbow ticking around the clock, hour and minute hands highlighted with red and blue, constant brightness.

2 Constantly full bright rainbow ticking around the clock, hour and minute hands falling into shadow.

3 A bright rainbow ticking around the clock, dimmed at night.

4 A constantly medium bright rainbow ticking around the clock.

5 A constantly full bright rainbow ticking around the clock.

6 A bright rainbow ticking fast around the clock, dimmed at night.

7 Medium bright rainbow ticking fast around the clock, hour and minute hands highlighted with red and blue, constant brightness.

8 A constantly full bright rainbow ticking around the clock, but slowly with the minutes.

9 A bright rainbow ticking around the clock, but slowly with the minutes, dimmed at night.

10 Solid color cycling through the rainbow, changing with every second, dimmed at night.

11 Solid color cycling through the rainbow, changing with every second, full brightness.

5   Changing the background

The background is just a paper circle with a diameter of 185 millimeters. Use the graphics program of your choice to design it. We recommend Inkscape, although you likely will need to google the method to distribute 12 objects evenly spaced around a circle.

We think that a grayscale design looks better under the colored lights, but if you want a design

that plays with being bathed in light of changing color, go for it! This can lead to some very interesting effects!

Don't forget to mark a center and a cutting perimeter in your drawing.

To swap it, you need to first power off the clock. Then you need to remove the front pane of the clock. Locate the three nubs on the backside of the clock poking out of the perimeter and push them in using e.g. a flat screwdriver.

Be very careful not to damage the copper wires between the LEDs in the process!

Use the same screwdriver to push the pane further out the front, then pull the pane off from the front using your fingers.

Remove the three clock hands by tentatively pulling them off. Change the background paper. Don't put the new one on top of the old one, this might be getting too thick and/or wavy and the hour hand should never scrape on the paper!

If in doubt, use some bits of double sided tape to fix the new background to the case.

Reattach the three clock hands by putting them all in the 12 o'clock position, else the hours hand might seem to be off after you adjust the clock. Squeeze the front pane in so that the nubs align to their slot in the case, then push the whole front pane back into its place.

Double check that the paper does not billow up by the pressure of the pane on its perimeter and hinder the natural way of the hours hand. If in doubt, remove the front pane again and use more double-sided tape . . . or find a way to push the pane back in without the paper billowing up. The latter is not easy, but in most cases possible. That much we can tell you from our own experience.

6 Firmware upgrade

If, for some reason, a firmware upgrade is needed, it is administered through the micro USB port on the back side of the clock.

Right next to that port, by the way, is a small hole to access the reset button, which you will not need unless you choose to hack around with the clocks firmware yourself. Do ask for our source code, we will happily provide it along with some pointers on how to get started using the Arduino IDE.

Here's the basic data: The chip is an ESP8266 on a WeMos D1 mini board with a CH340G USB-to-Serial converter to program it. The LEDs are of the type "WS2812b" in GRB color byte order, connected to pin D4. LED 0 is on the clocks position 11, counting anticlockwise; the function to calculate from the intuitive position number (a.k.a. hours) to the actual led number is

$$lednumber(h) = 11 - (h \bmod 12)$$

with h being the "intuitive" hour position.

The mode button is active low, connected to pin D3 with an internal pull-up resistor.

7 Summary

Are you happy with your new clock? Then tell your friends that they have no chance of getting the same clock, unless they somehow manage to lay their hands on such a fine collectors item named RIBBA.

Even then, they'll have to ask us for the source code and shopping list — and they'll need a steady hand to solder it.