



Linear clock

user manual

Introduction

This manual describes the functionality and configuration of the linear clock. The linear clock is a project made by Jan Derogee. The entire project was created with the idea to make the mechanical part as simple as possible. This mainly with the intention that it could be easily reproduced by anyone. No special hardware or expensive parts required, only cheap and “off the shelf” parts that can be found in most hardware stores. This project also does not require the use of special limit switches, brushed contacts or an expensive spindle or nut.

I wanted to make this clock for many years but never took the time because I felt that it should be as easy to use as possible with the minimum of components, no display no buttons. It was mostly the revolution of the ESP8266 wifi module that made this project possible in an affordable (extremely cheap) and practical manner.

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1 The linear clock

1.1 Concept

The idea behind the linear clock is mainly to be a different kind of time indicator. This because for some kind of people, indicating time by two rotating indicators isn't as easy as for others. For some it is far from convenient for others it is plainly confusing. In those cases a linear clock could be of use to small children who are not familiar with the concept of or capable of telling time using conventional clock. But for those who don't have trouble reading regular clocks, a linear clock can still be pretty to look at, decorating your wall and be a nice conversation starter when you have a visitor.

By representing time on a line (where the left side of the line represent night and morning and the right side represents afternoon and evening the complete overview of the current time/position of the day is indicated.

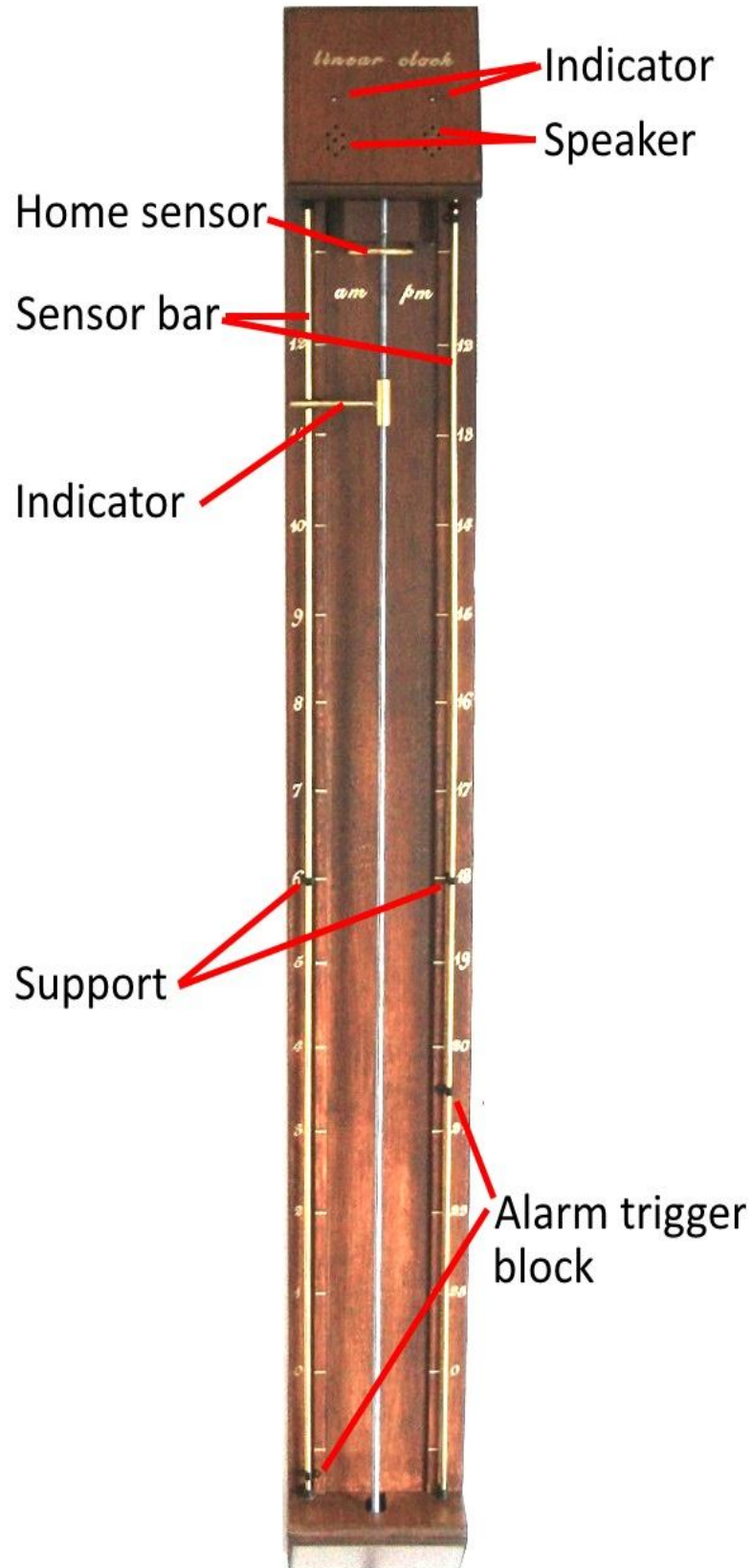
Indicating constantly repeating events at specific times along the day (think of breakfast, lunch, diner) is much easier when the whole day is represented. This could be of great use for learning rhythm and the concept of time to small children but could certainly be helpful in creating order and structure for autistic people who lack the skill of the concept of time and therefore cannot handle the method of representing the conventional way of displaying time.

1.2 Definition of the time scale

As can be seen on the photo on the next page, the timescale is defined in 2 sides. The left side (where the pointer moves upwards) indicates the time 00:00 – 11:59 and represents night and morning also known as AM. The right side of the clock indicates the time 12:00 – 23:59 and therefore represents afternoon and evening also known as PM.

Looking at the scale it becomes clear that the pointer moves in a similar way like the sun in our sky, it rises in the morning and sets in the afternoon.

2 The clock's parts



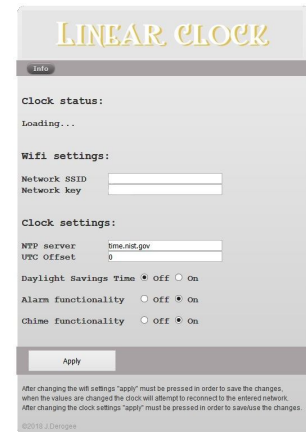
3 Configuration

This chapter will describe how to connect to the configuration page of the linear clock with an ordinary web browser and phone/tablet.

3.1 Connecting to your home network

The linear clock has several settings that are required for correct operation. And although the clock has no display or button, it does feature a convenient web-interface through which these values can be altered.

However... when you first use the linear clock, it has no configuration for connecting to your home network and therefore it cannot connect to it. In order to allow you to access this configuration web-interface, the clock must create it's own network. Therefore allowing you to connect to it using your mobile phone or tablet.



The screenshot shows the 'Linear Clock' web interface. At the top, the title 'LINEAR CLOCK' is displayed in a gold, serif font. Below the title is a 'info' tab. The main content area is divided into three sections: 'Clock status:' showing 'Loading...', 'Wifi settings:' with input fields for 'Network SSID' and 'Network key', and 'Clock settings:' with fields for 'NTP server' (set to 'time.nist.gov') and 'UTC Offset' (set to '0'). There are also radio buttons for 'Daylight Savings Time' (set to 'Off'), 'Alarm functionality' (set to 'Off'), and 'Chime functionality' (set to 'Off'). An 'Apply' button is located at the bottom. A small disclaimer at the very bottom states: 'After changing the wifi settings "apply" must be pressed in order to save the changes, when the values are changed the clock will attempt to reconnect to the entered network. After changing the clock settings "apply" must be pressed in order to save the changes.' The footer shows '©2018 J.Donaghy'.

This is what you need to do on your phone/tablet:

Step 1: go to the wifi configuration page of your phone/tablet

Step 2: scan through the list of available networks

Step 3: connect to the network **Linear clock**

Step 4: open a web browser on your phone/tablet

Step 5: enter the IP address **192.168.1.1** as an URL in your browser

Step 6: after a few seconds the configuration page will appear in your browser

Step 7: make sure you have the correct SSID and KEY values of your home network at hand

Step 8: change the settings of the SSID and KEY to the values of your home network

Step 9: when you've changed the values and pressed the **apply** button the created network **Linear clock**, will close and the clock will attempt to connect to your home network

Step 10: when SSID and KEY are correct, a cheerful sound will be heard and the LED will turn off. The clock will also be accessible through a browser on any computer/phone/tablet connected to your home network.

But when the settings are not correct, it will fail and you must return to step 3:

3.2 Settings

Below a screenshot of the configuration page of the linear clock. Although some settings are self explanatory, the next few chapters will describe each function in detail.

LINEAR CLOCK

Info

Clock status:

Loading...

Wifi settings:

Network SSID

Network key

Clock settings:

NTP server

UTC Offset

Daylight Savings Time ☒ Off ☐ On

Alarm functionality ☐ Off ☒ On

Chime functionality ☐ Off ☒ On

Apply

After changing the wifi settings "apply" must be pressed in order to save the changes, when the values are changed the clock will attempt to reconnect to the entered network. After changing the clock settings "apply" must be pressed in order to save/use the changes.

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3.2.1 SSID

The SSID field should hold the name of your home network.

3.2.2 Key

The Key field should hold the network key (or password) of your home network.

3.2.3 NTP server

The linear clock requires an NTP server in order to function. Because this is where the clock gets the time from. The clock sets its own internal clock to the NTP server time reference and is therefore very accurate. The NTP server is contacted every hour to keep the linear clock counter as accurate to the real time as possible.

A very good time server (and therefore set as the default value) is: **time.nist.gov** But if for some reason this fails to function there are many others and the clock allows you to change that setting.

3.2.4 UTC offset

The time that is received from the NTP server is according to the “coordinated universal time” or UTC for short. UTC is not affected in any way, so local jurisdictions regarding time zones or daylight saving time situations have no effect on the UTC value. This means that it is a world wide accepted universal time value that always requires an offset to be added in order to get the local time. For instance

Greenwich = UTC+0	therefore fill in 0 in the UTC offset field if you use the clock there
Amsterdam = UTC+1	therefore fill in 1 in the UTC offset field if you use the clock there
Chicago = UTC-6	therefore fill in -6 in the UTC offset field if you use the clock there

For places that have timezones that are not a multiple of an whole hour an extra value can be added after the hour. But this fraction isn't in minutes but in parts of an hour. Therefore 15 minutes is 0.25 (because 15 minutes is $0.25 * 60$). 30 minutes is 0.5, 45 minutes is 0.75, etc.

Venezuela = UTC-4:30	therefore fill in -4.5 in the UTC offset field if you use the clock there
Nepal = UTC+5:45	therefore fill in 5.75 in the UTC offset field if you use the clock there

For more information about timezones you can visit https://en.wikipedia.org/wiki/Time_zone

Keep in mind that the offset from UTC is always without DST, in other words the offset is always related to wintertime. In order to add an extra hour because of summertime you should turn the DST setting to ON. Do not add the extra DST hour to your UTC offset setting but use the DST ON/OFF twice a year to switch between winter- (off) or summer-time (on).

Note:

If you live in an area that uses daylight savings time and it is summer time then if you live for example in a timezone that has an offset of +1 related to UTC, then do not fill in +2 to make the displayed time on the clock be correct. Just use offset +1 and set DST to ON. That would be the only correct way to configure your clock.

3.2.5 Daylight savings time

Daylight savings time or DST for short is a method of saving energy by messing with the clock. Therefore using the daylight more efficiently energy resources are less needed. Now this sounds nice in theory but in practice it is all very confusing because there are different DST changeover moments through the world, twice a year. Therefore in order to keep the design of the clock as easy as possible, DST is not automatic. Therefore the user must change the setting from OFF to ON and vice versa twice a year. When the summer begins DST should be set to ON and during winter DST should be set to OFF. The only thing that happens when DST is ON is that an extra hour is added to the local time.

3.2.6 Alarm

The clock features an alarm function, by placing alarm blocks along the brass sliders alarm event can be generated when the indicator passes over them. This functionality can be completely disabled, meaning that when it is in the OFF situation, the alarm blocks will be completely ignored.

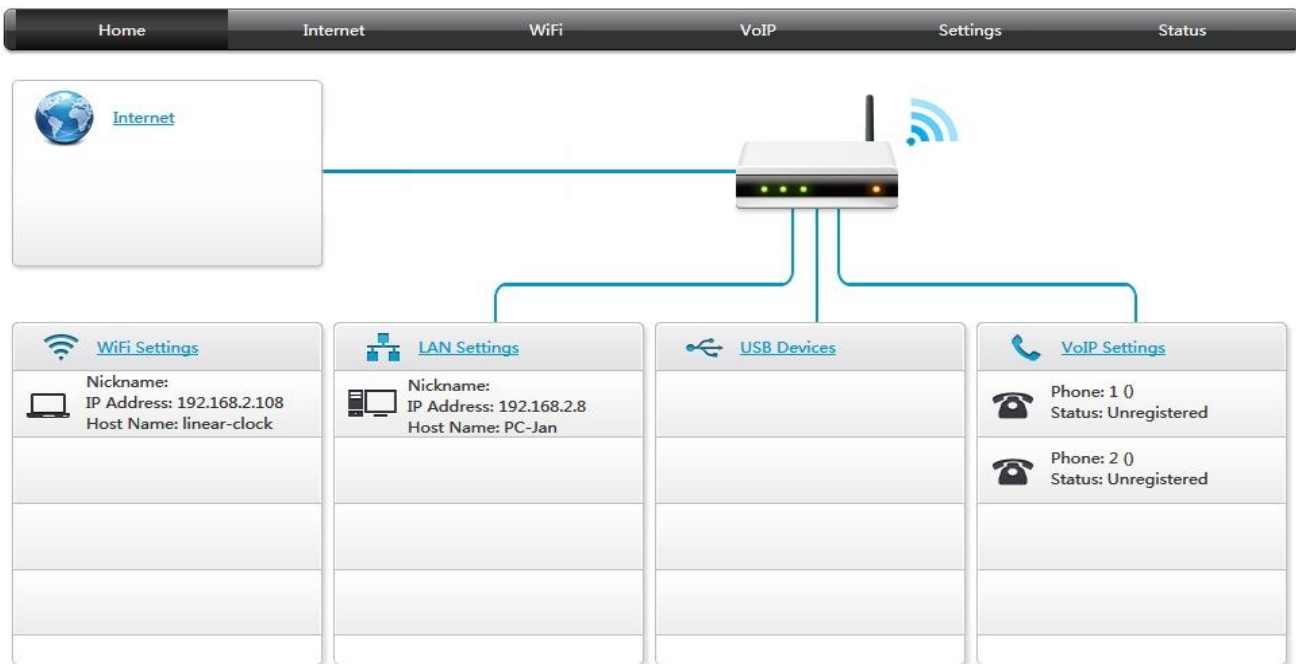
3.2.7 Chime

The clock makes sounds, every quarter and on the hour. On the quarters the sound is just a tiny bell sound. On the hour it sounds a short melody followed by a loud bell for every hour. So when it's ten o'clock, the loud bell sounds 10 times. The bell never sounds more than 12 times, so when it's 13:00 hours, the clock sounds just a single loud bell (not 13). Just like any other regular old chiming clock.

3.3 The IP address

The Linear clock, when properly configured, can connect to a wifi network. In order to reach the clock from your browser, you must know the IP address of the clock. Although this information is printed to the internal serial port for debugging, it is invisible to the regular user. Fortunately there are other ways to get this information.

One way would be to login the wifi-router that hosts the network. There you can see the list of currently connected devices (or recently connected devices). Below is a screenshot of the configuration menu of a router for an ordinary home network. In the list “Wifi settings” (on other routers this may be called “attached devices”) there are 2 devices listed, both the IP-addresses are shown. The linear clock is indicated by the hostname “linear-clock” and therefore can easily be found.



Another way could be by using a special app on your phone. One of those apps is “Fing” but this will not be described in this manual.

However... while using the IP-address always works, there is an easier way. But depending on your router and your browser this may not always work. You can connect to your clock by typing in your device's hostname followed by a / into the URL of your browser. So for the linear clock this would mean that the URL **linear-clock/** must be entered in the browser. This is a lot more convenient than using the IP address method. Unfortunately this functionality cannot be guaranteed for all configurations and has proven difficult for some users.

4 Sounds

4.1 Alarms

The linear clock is capable of sounding an alarm at the desired time. An alarm event can be generated by preventing electrical contact between the indicator and the left or right sensor bar for more than 3 minutes. In order to create this situation the alarm trigger block(s) can be placed at the desired location on the time scale / sensor bar.



Even though the width of an alarm trigger block is 6mm wide this doesn't mean that the alarm will sound for the complete length of the block (6minutes). It sounds only when the indicator is at the center of the alarm trigger block. You may use as many trigger blocks as you like as long as they are at least 3mm apart. So that the indicator can always touch the sensorbar after an alarm event has been detected.

Due to the fact of the sensorbar being supported by an insulating part at the center of the sensorbar, alarm functionality close to the hours 6 and 18 is not possible.

When alarm functionality is not required the alarm trigger block(s) can be removed completely, but better is to slide them to the outer limits of the timescale. This way they don't get lost.



Alarms can also be completely disabled by changing the setting in the configuration menu. There when using the alarm functionality, make sure it is turned on in the settings.

4.2 Chimes

The design of the clock is like an old-skool or grandfather style clock. These clocks make sounds and therefore the linear clock also has these sounds.

The clock chimes at the whole hours indicating time with a short chime for each hour. Though to prevent it from making too much sound the clock chimes max 11 times.

5 Error codes

To indicate problems the clock has an indicator light that blinks in a special rhythm. This way there is no need for a display indicating the problem. Keeping the clock easy to build and pretty to look at. Because displays sometimes can completely ruin the look of a design.

The light blinks for ... times and then pauses for 3 seconds and then repeats the pattern. Finding out the error code of the current problem, just count the blinks.

When the linear clocks starts, it will light the indicator lights continuously, when it is connected to the configured home network, the lights will go out and normal operation will resume.

5.1 Error code #1

Undefined error code.

This code does not exist, simply because it is a slightly confusing code. Blinking only once makes it confusing to count the blinks.

5.2 Error code #2

This code is reserved for future use.

5.3 Error code #3

Problem:

Mechanical error. The system could not detect the home reached signal.

Solution:

Check the electrical contacts (pointer) and the curved sensor bar at the top of the clock. The curved sensor bar is merely for making the clock look symmetrical and has no further functions.

5.4 Error code #4

Problem:

NTP server error. The system could not connect to the NTP server.

It is very normal that this error occurs, this because the server fails to respond within the set timeout value. Though, sometimes this is just too short for the server to respond. Then again sometimes the server doesn't respond at all. The clock simply will try again within a few seconds and in many cases the problem will be solved just by waiting 15 seconds. However is this problem persists for more then 3 minutes, then there is could a serious problem that requires investigation.

Solution:

If this error persists for more then 3 minutes, check if the configured NTP server can be reached. If not then change the NTP server configuration in the settings menu for a server that does respond.