Building a smart HomeKit thermostat with ESP32

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Intro

- primarily a full-stack web developer
  (Node.js, Go, React.js)

- IoT and automation as a hobby
  (ESP32, Arduino, RPi, Home Assistant, …)

- jozefcipa.com/blog

Goals & Motivation

- remote control
- no 3rd party app needed
  => *should support Apple Homekit*
- instant visual feedback (display)

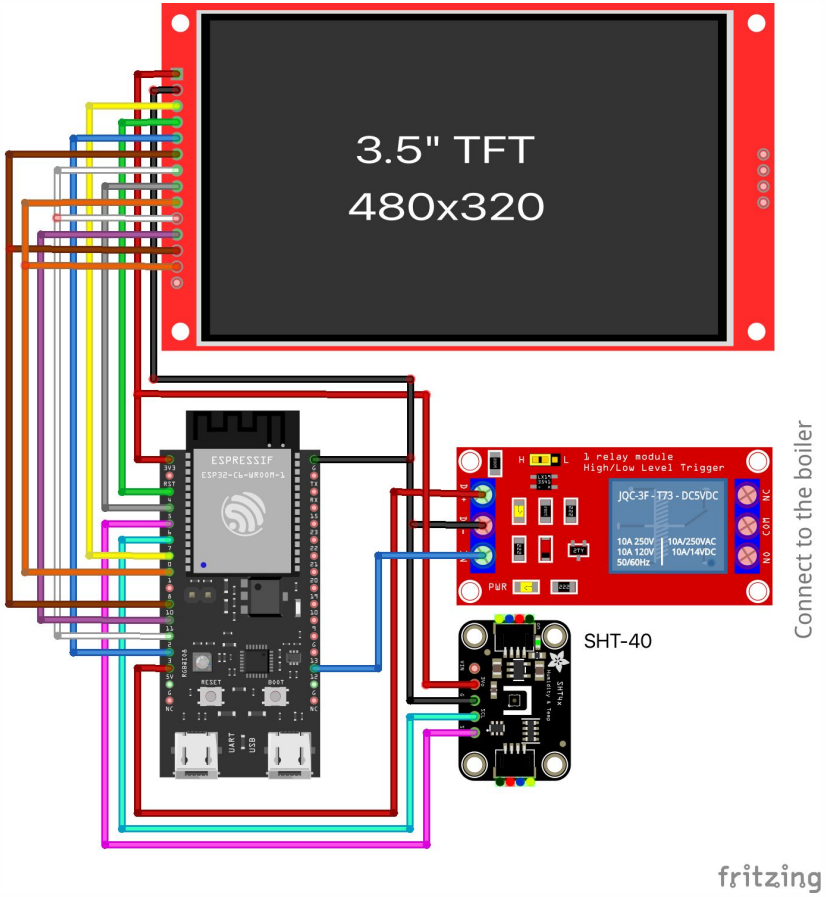
- official thermostats were quite expensive
- learn more about ESP32
- have fun :)

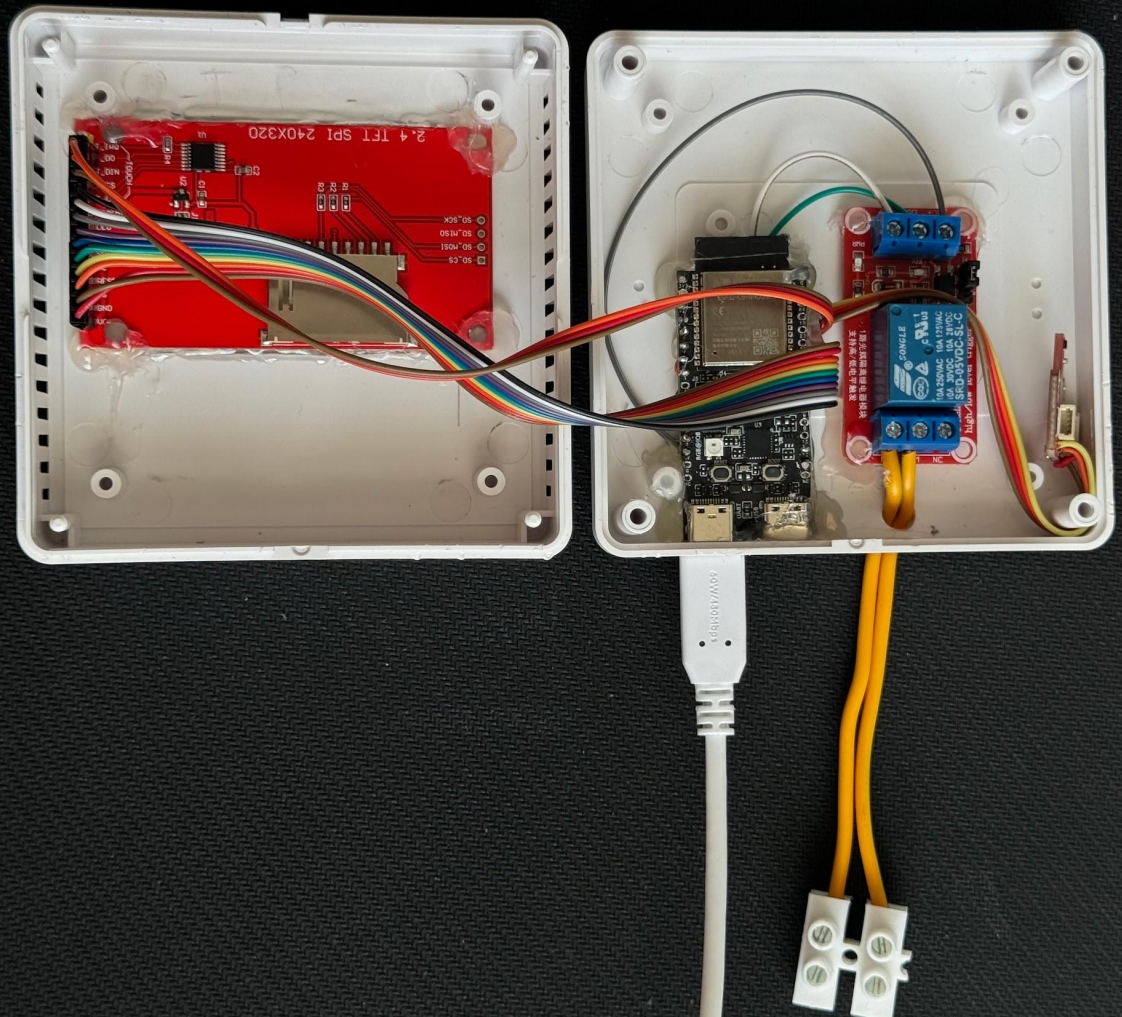
https://www.istockphoto.com/cs/portfolio/Anastasiia_New

Hardware

- ESP32-C6
- relay module for controlling the heater
- temp/humidity sensor (SHT-40)
- 3.5” TFT touch screen

- total price ~ 500Kc (excl. esp32)




2.4 TFT SPI 240X320
SD_SCK
SD_MISO
SD_MOSI
SD_CS
TOUCH
SRD-05VDC-SL-C
10A 250VAC 10A 125VAC
10A 30VDC 10A 28VDC
NC

Software - Flow

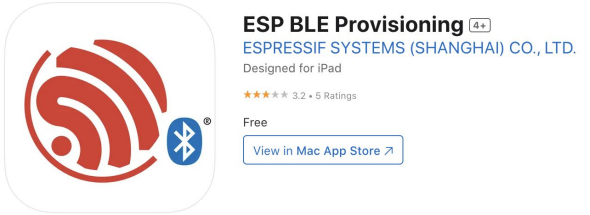
github.com/jozefcipa/homekit-thermostat/

1. init HW components
   (disable LED, setup I2C, GPIO config)
2. config LCD display and GUI library
   (SPI, render task, touch setup, ...)
3. create event loop
   Wi-Fi event handlers - conn / disconn / provisioning request
   readiness signal (needed for Homekit, temp sensor, etc.)
4. setup a WiFi connection
5. start the Homekit server
   register event handlers for communication with the Apple Home app
6. register tasks
   (update time, check temperature)
7. thermostat ready 🚀

WiFi Provisioning

- seamless and robust Wi-Fi setup
- scan a QR code via iOS / Android app
- automated recovery or config reset on network failure

- 2 QRs (Wi-Fi & Homekit setup) needed as it isn't an official Apple MFi certified device ⚠️



esp32-homekit

- implementation of the **Apple HomeKit Accessory Protocol (HAP)** for ESP32 using ESP-IDF
- allows ESP32 to act as HomeKit accessories (lights, sensors, switches, etc.)
- comes with a **ton of examples** for majority of supported accessories
- includes useful toolings

https://github.com/AchimPieters/esp32-homekit

GUI

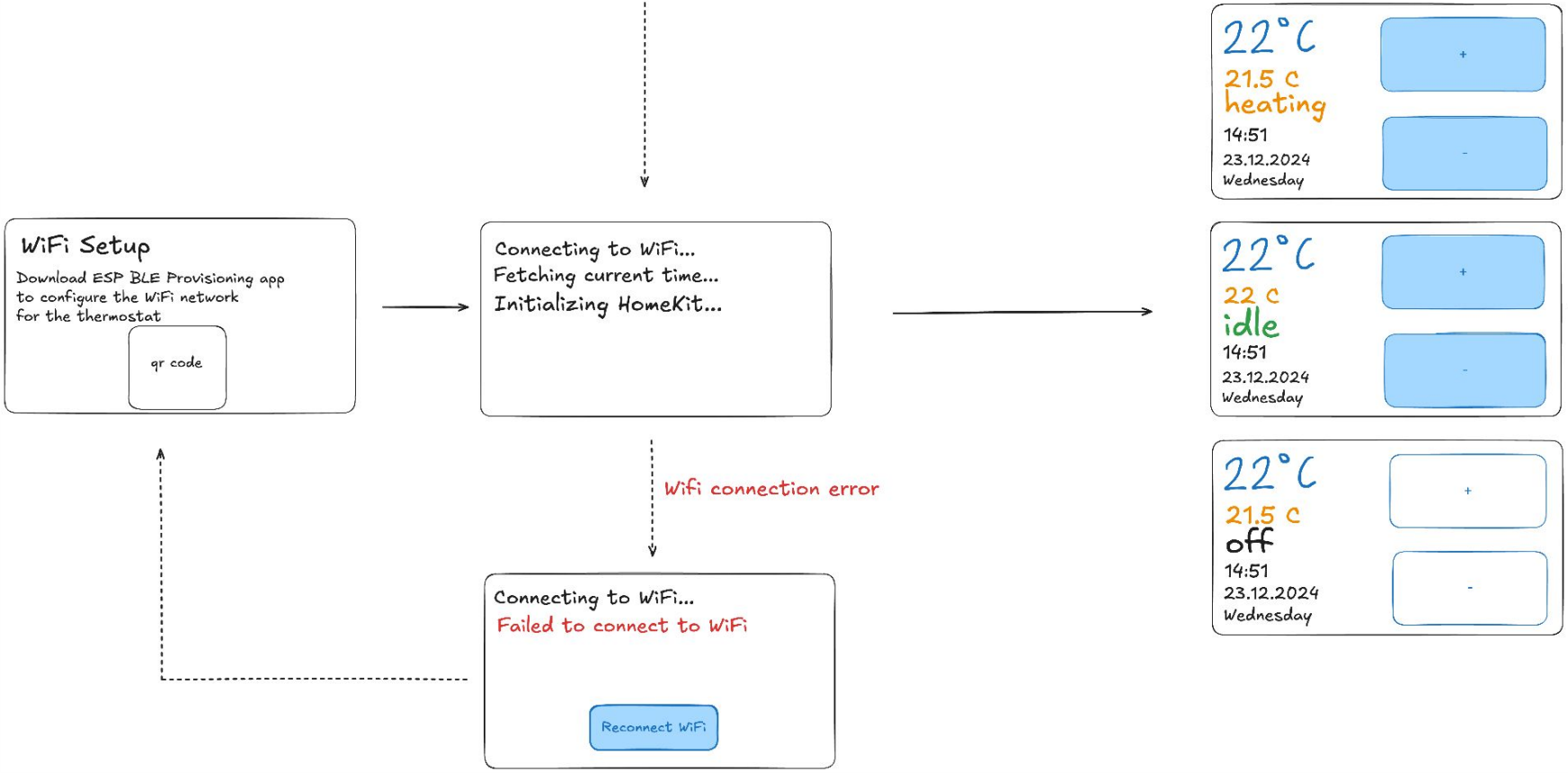
- LVGL graphic library (https://lvgl.io/)
  - super easy to use
  - styling via CSS-like properties
- multiple screens needed
- touch support
- current date & time via NTP protocol

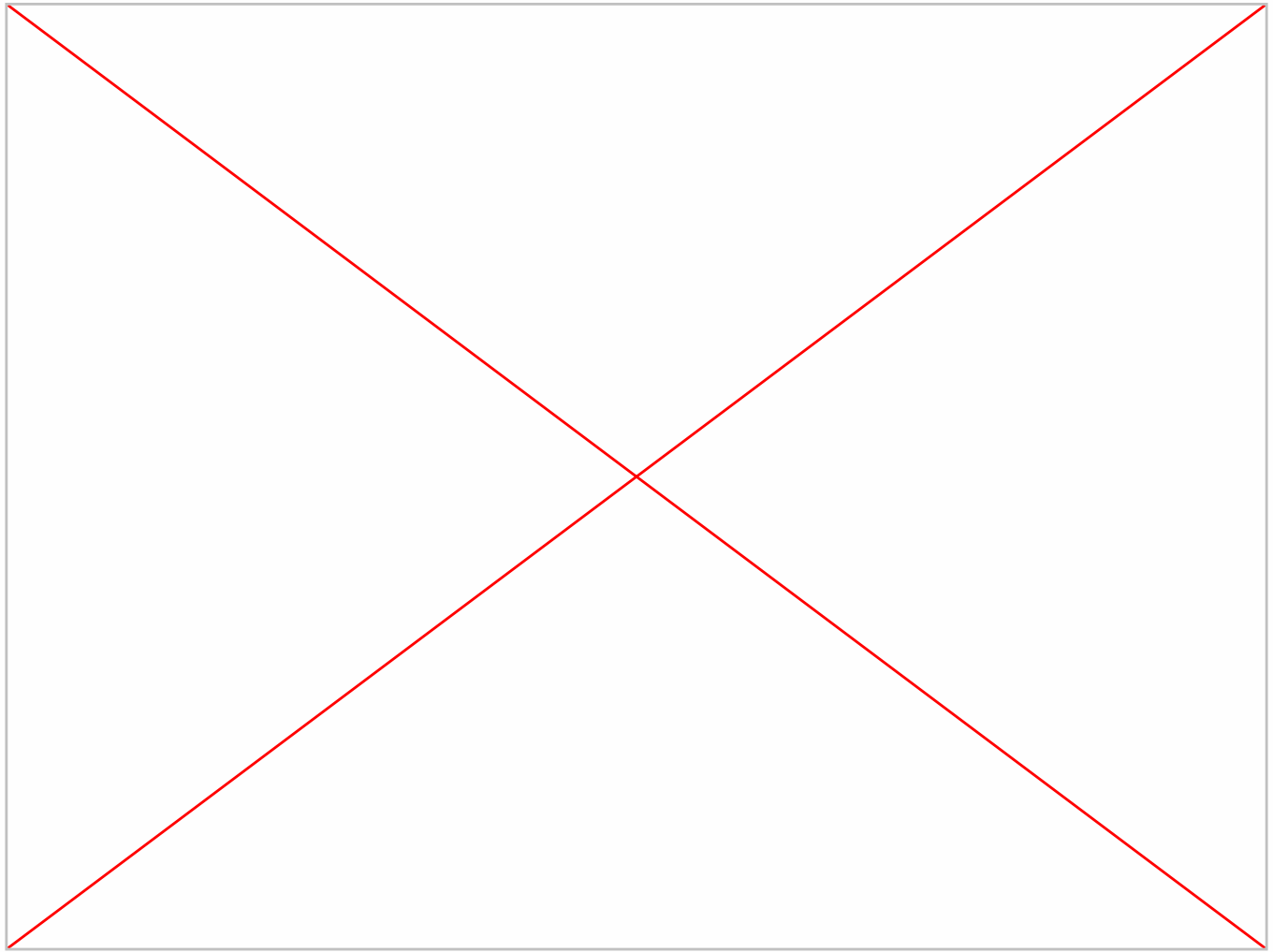
WiFi Setup screen

Loading screen

Main screen

Wifi disconnected





Thank you!

github.com/jozefcipa/homekit-thermostat
jozefcipa.com/blog/how-i-built-a-custom-homekit-thermostat-for-40eur/

Questions? Contact me!
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