Building an FM Radio Station with Go

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Motivation for this project

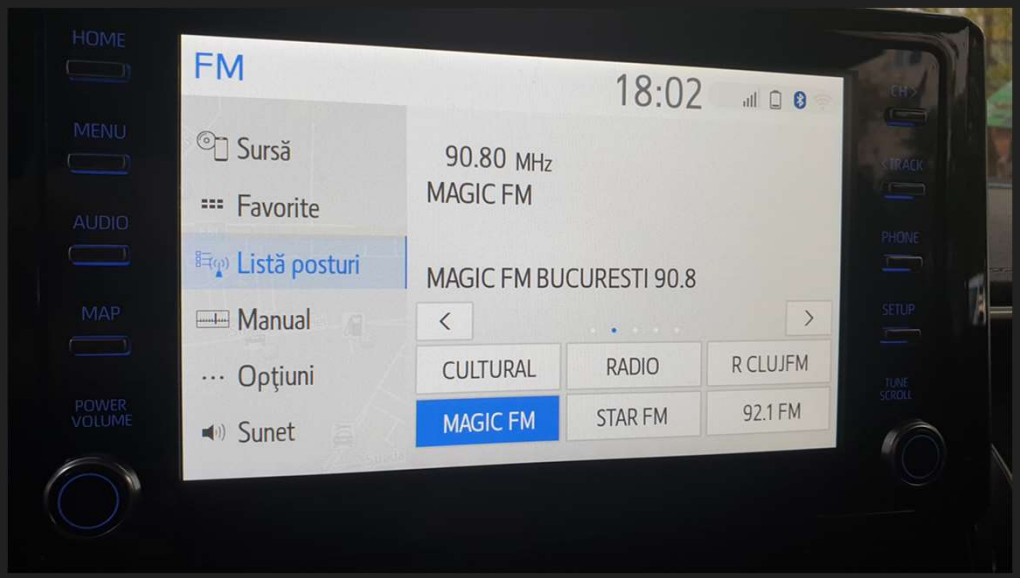
- Fun
- Not yet another microservice
- Learn something new

Motivation for this project

- Something useful for my car
- Provide TMC data to my car's navigation

What is this RDS stuff?

- Radio Data System (RBDS - Radio Broadcast System in US)
- Additional data transmitted by FM radio stations



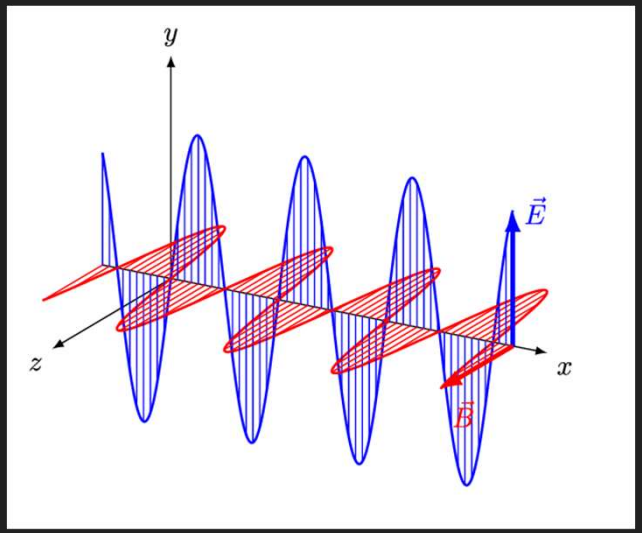
Short introduction to Radio Waves

Short introduction to Radio waves

- Are a form of ElectroMagnetic Radiation (EM)
- Natural or Artificial

Radio waves properties

- Speed
- Length (aka wavelength)
- Frequency

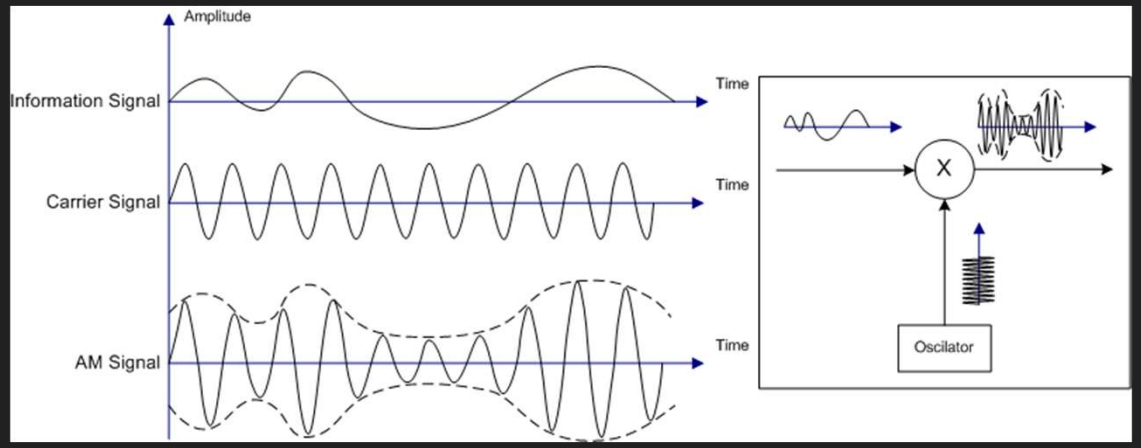


Broadcasting using Radio waves

- Amplitude Modulation (AM)
- Frequency Modulation (FM)
- Digital transmissions:
  - Digital Audio Broadcast (DAB)
  - HD Radio (HDR)
- etc.

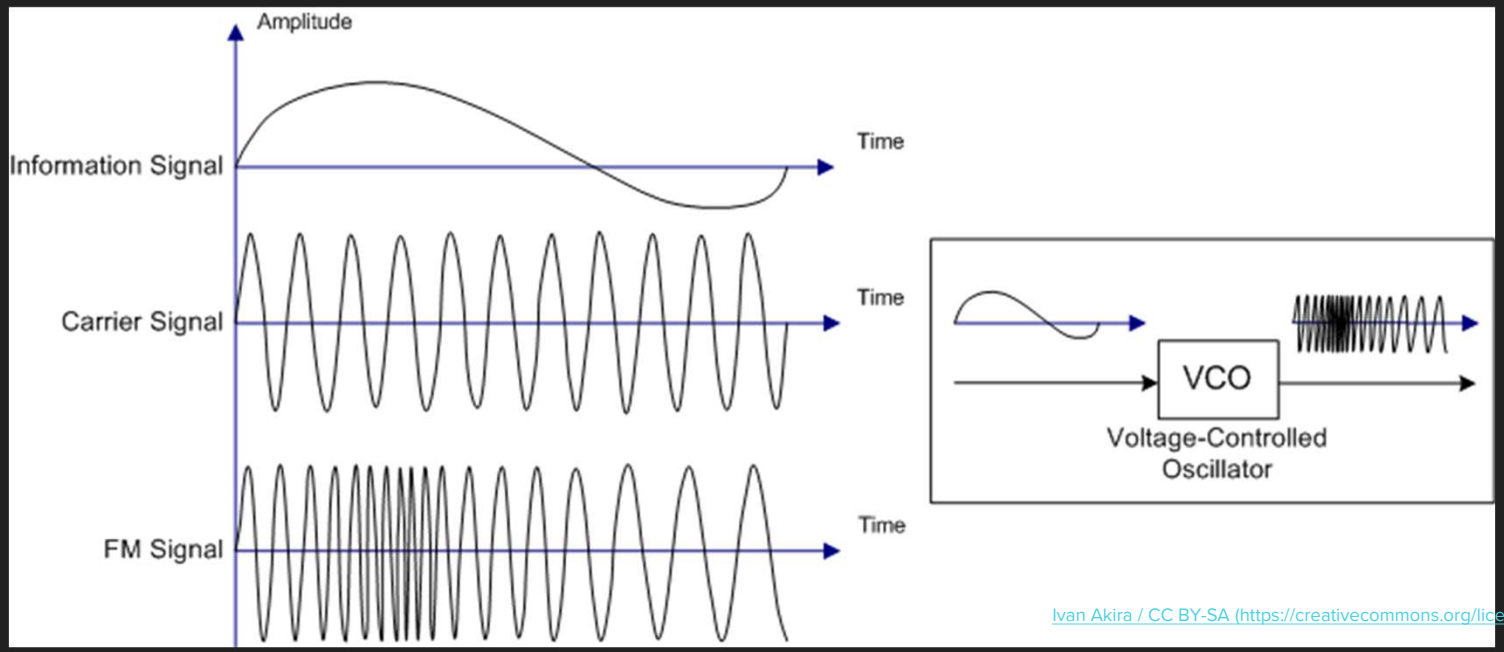
Amplitude Modulation (AM)

- Varies signal strength to transmit data



Frequency Modulation (FM)

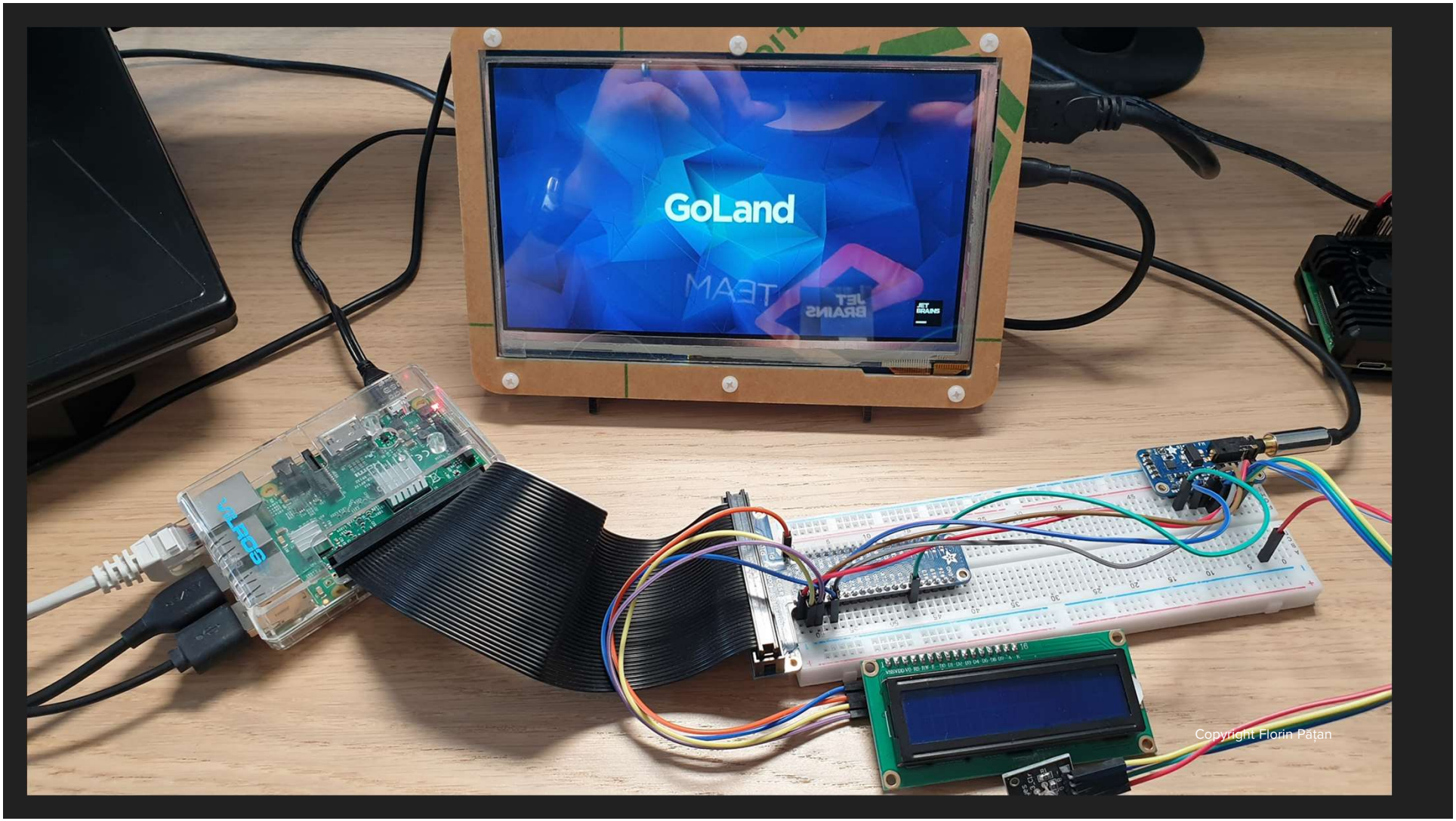
- Varies the instantaneous frequency to transmit data



Newer broadcasting formats

- Digital Audio Broadcast (DAB, DAB+)
  - Available since the mid '90s
  - Still not widely used
- HD Radio (HDR)
  - Mainly used in the US, Canda, Mexico and a few of other places
  - Around since 2002

Overall presentation of the system


GoLand
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Raspberry Pi

- Credit card sized, single-board computer
- First appeared in 2012
- Meant to be an educational tool
- Over 30 million devices sold
- Used in everything from simple apps to robotics
- Multiple device released

Raspberry Pi 4

- Quad-core ARM-based SoC
- Up to 8GB of RAM
- Up to 1x 4K@60Hz display or 2x 4K@30Hz displays


Raspberry Pi 4 Model B
©Raspberry Pi 2018
GPIO
DISPLAY
RUN GLOBAL_EN
J2
FCC ID: 2ABCB-RPI4B
IC: 20953-RPI4B
Made in the UK
HDMI
CAMERA
A/V
POWER IN
HDMI0
HDMI1
USB2
Trxcom
TRJG0926HBNL
China M 1937
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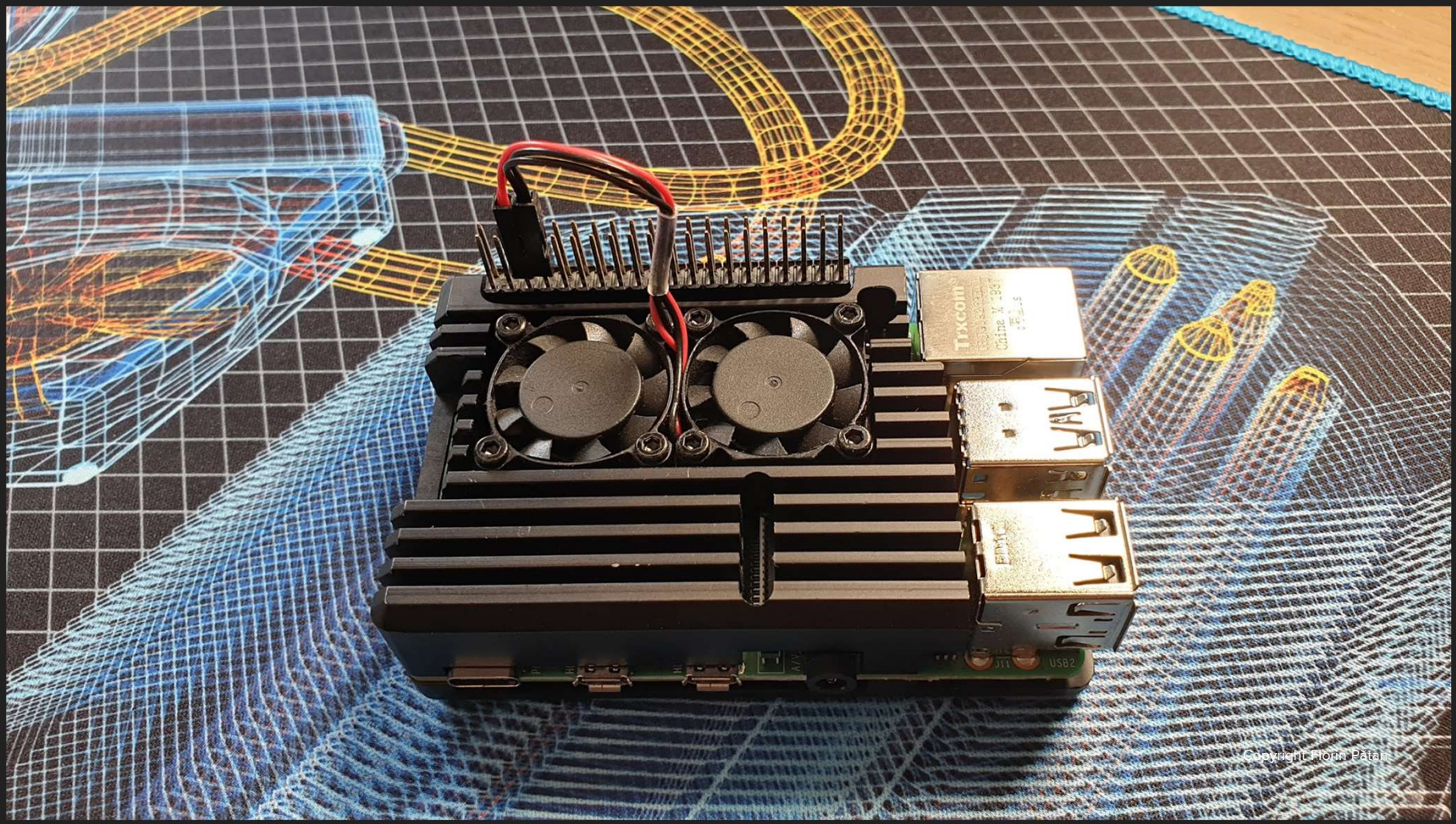
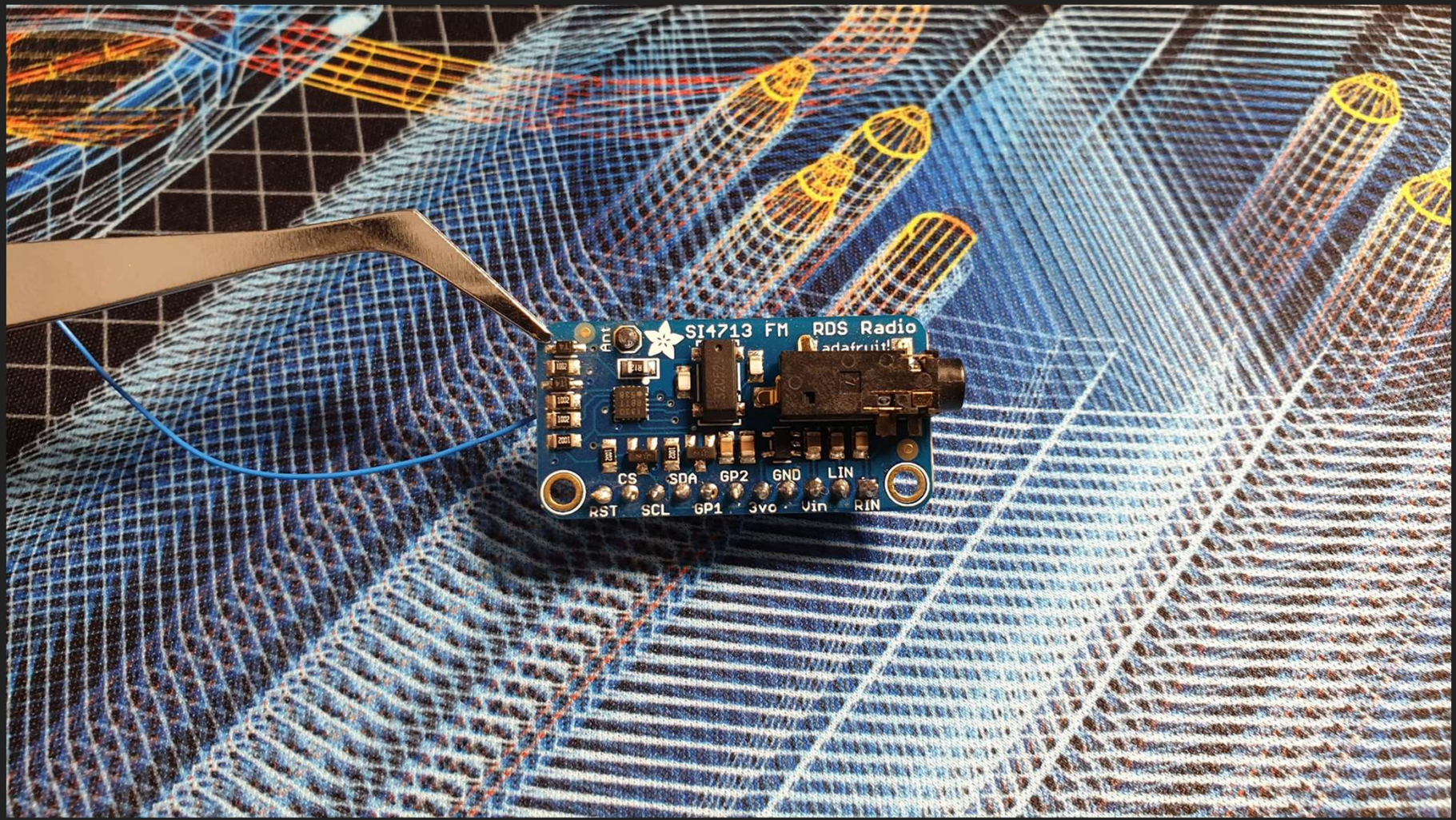

Tryconn
USB2

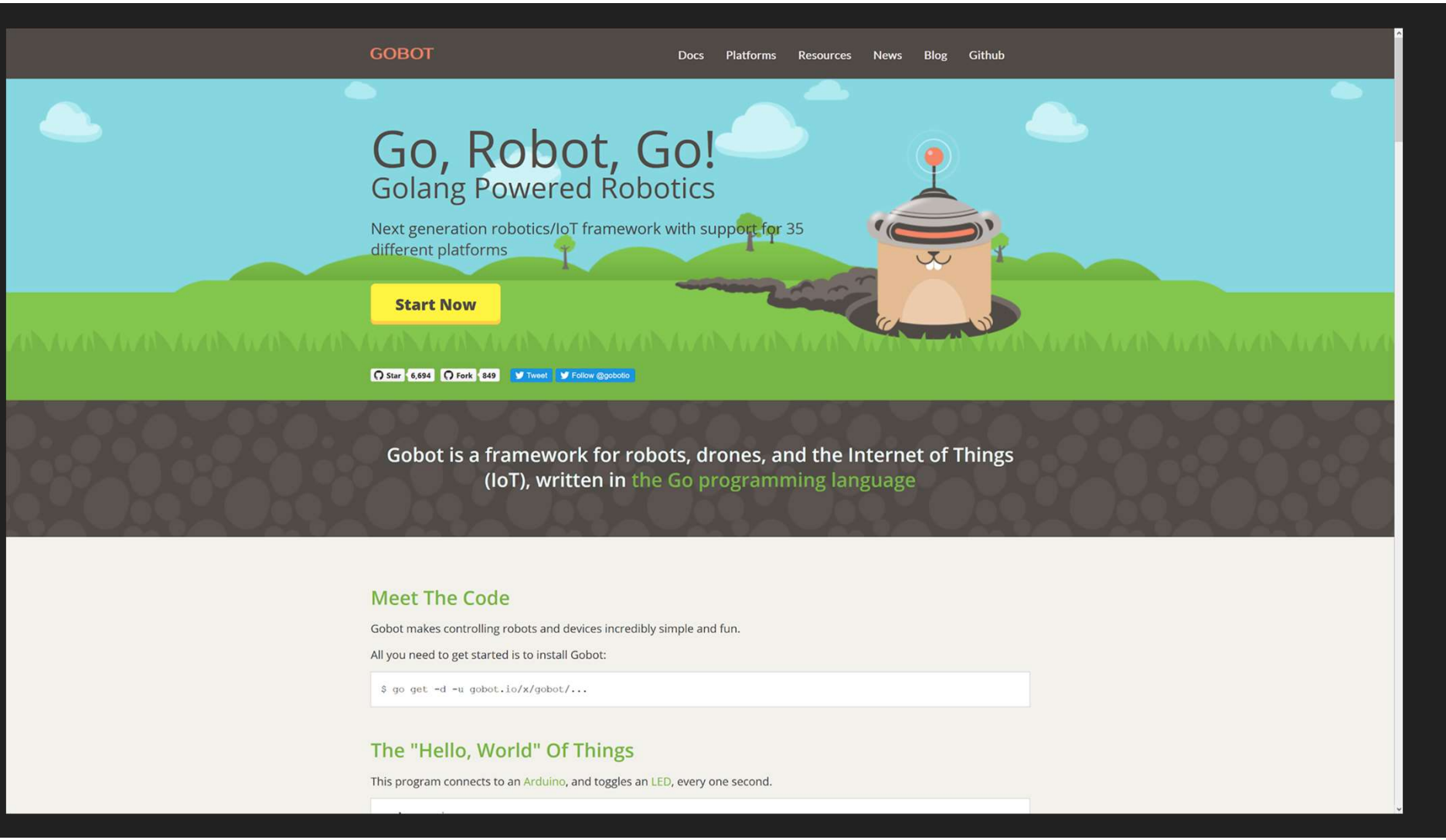
Adafruit Si4713 FM Radio Transmitter

- Based on Silicon Lab's Si4713 chip
- Can send RDS/RBDS
- Transmission range of up to 10 meters (30 feet)
- Receives commands via I2C
- Drivers available in C and Python (but not Go)


SI4713 FM RDS Radio
Ant
CS
SDA
GP2
GND
LIN
RST
SCL
GP1
3Vo
Vin
RIN

Gobot

- A framework for robots, drones, and IoT devices
- Stable
- Supports around 30 different platforms as run targets
- Supports a lot of devices out of the box
  - 19 GPIO (General-Purpose I/O) devices
  - 5 AIO (Analog I/O) devices
  - 9 SPI (Serial Peripheral Interface) Drivers
  - 24 I2C (Inter-Integrated Circuit) Drivers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Go, Robot, Go!
Golang Powered Robotics
Next generation robotics/IoT framework with support for 35 different platforms
Start Now
Star 6,694
Fork 849
Tweet
Follow @gobotio
Gobot is a framework for robots, drones, and the Internet of Things (IoT), written in the Go programming language
Meet The Code
Gobot makes controlling robots and devices incredibly simple and fun.
All you need to get started is to install Gobot:
$ go get -d -u gobot.io/x/gobot/...
The "Hello, World" Of Things
This program connects to an Arduino, and toggles an LED, every one second.

Show me the Code

Does it work?

Conclusion

- We can use Go for more than servers/APIs/CLIs
- Gobot makes things easy to prototype
- Writing a Go driver based on existing C/Python was can be relatively straightforward
- All my neighbors can now enjoy my musical taste

Components list (mandatory)

- Si4713 breakout board: https://www.adafruit.com/product/1958
- Raspberry Pi 4 with 8GB: https://www.adafruit.com/product/4564 (can be a lower model)
- The Raspberry Pi case: https://www.adafruit.com/product/4340
- Stacking header: https://www.adafruit.com/product/1979
- Breadboard: https://www.adafruit.com/product/239
- T-Cobbler: https://www.adafruit.com/product/2028
- Jumper cables: https://www.adafruit.com/product/758
- Jumper cables: https://www.adafruit.com/product/826
- Audio cable: https://www.adafruit.com/product/876

Components list (optional)

- Soldering iron: https://www.adafruit.com/product/4695
- Soldering iron stand: https://www.adafruit.com/product/150
- Helping Third Hand with Magnifier: https://www.adafruit.com/product/291
- Small LCD: https://www.sunfounder.com/i2clcd.html (more components via https://www.sunfounder.com/37-modules-sensor-kit-v2-0-for-raspberry-pi.html)
- Proper display for a Raspberry Pi: https://www.adafruit.com/category/506
- FM Receiver: https://www.adafruit.com/product/1497

Questions?

Thank you for watching!

References

What is TMC? https://en.wikipedia.org/wiki/Traffic_message_channel
What is RDS? https://en.wikipedia.org/wiki/Radio_Data_System
What is a Raspberry Pi? https://en.wikipedia.org/wiki/Raspberry_Pi
What is Electromagnetic Radiation? https://en.wikipedia.org/wiki/Electromagnetic_radiation
What are Radio Waves?

- https://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/txt_radio_spectrum.html
- https://www.livescience.com/50399-radio-waves.html
- https://en.wikipedia.org/wiki/Radio_wave

What is AM? https://en.wikipedia.org/wiki/Amplitude_modulation
What is AM Broadcasting? https://en.wikipedia.org/wiki/AM_broadcasting
What is FM? https://en.wikipedia.org/wiki/Frequency_modulation
What is FM Broadcasting? https://en.wikipedia.org/wiki/FM_broadcasting
What is DAB? https://en.wikipedia.org/wiki/Digital_Audio_Broadcasting
What is HD Radio? https://en.wikipedia.org/wiki/HD_Radio
Adafruit Si4713 Drivers:

- Python: https://github.com/adafruit/Adafruit_CircuitPython_SI4713
- C: https://github.com/adafruit/Adafruit-Si4713-Library