Convert competition device into a toy

- Device given during North Sec CTF competition in 2023 nsec.io

Competition ? NSEC ?

- What is Capture The Flag
  - Team game play during one weekend
  - Objective: Earn points by hacking software or hardware to retrieve a text Flag. *FLAG-THIS-IS-A-DEMO*
- What this device was used
  - Used to display information using a mesh network
  - Many flags available
  - Ambiant light linked to Competition badge
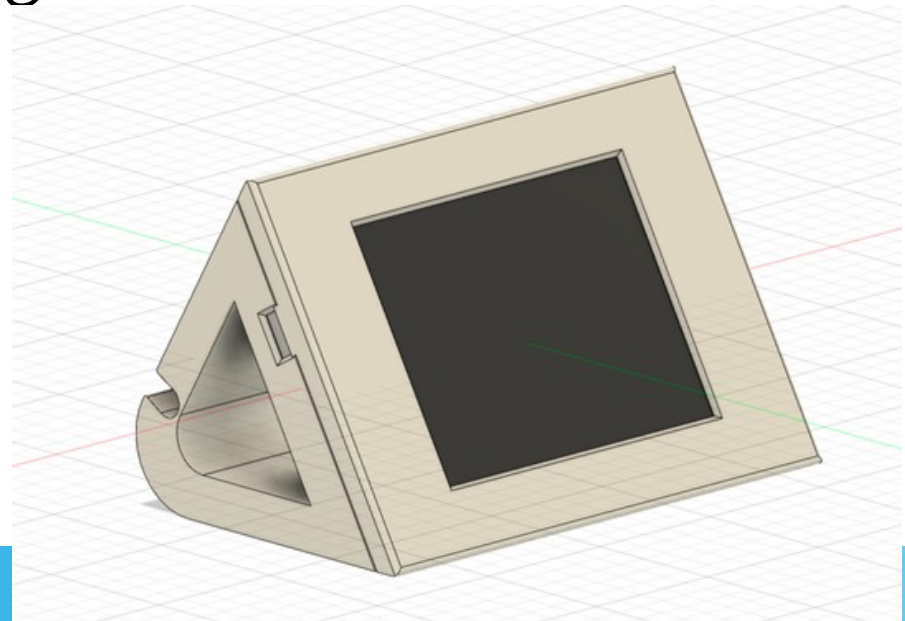
The Board

- Device is `ESP32-2432S028R` as known as ESP Cheap Yellow Display

- CHIP `ESP32-D0WDQ6` with wifi and bluetooth.

- Development software ESP-IDF `Espressif IoT Development Framework`

- Constraint : Device was flashed using secure boot by NSEC team
  - They release source code with secure boot keys and building tools
  - Not reversible as when enabled it break a fuse to avoid stock back
  - Langage C++ and user interface with LVGL v7
  - Real Time OS with FreeRTOS

Investigation on repurpose item

- **FAILED:** Evaluated use for other stuff and cancelled as required to many research to use with secure boot as for:
  - ESPHome
  - ESP development
  - Secure Boot on ESP cannot be disabled

- **New objective:** Create a toy
  - Idea: Game score for mini figures
  - Planned of completion: 1 month
  - Real time: 4 months some hours on weekends

How it was

Take source code from NSEC team and modify it

- Language C++ with ESP IDF

- Update scripts as not working as default

- Rebuild and flash to ensure everything works

- Remove components not used (Wifi, bluetooth, SD Card, ...)

- Build a new user interface

  - Modify existing one by try and fail

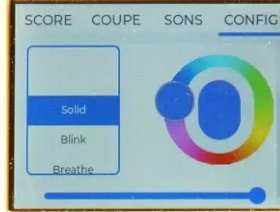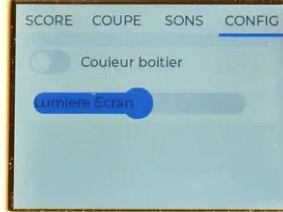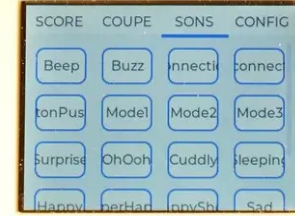 - Use a simulator in C language
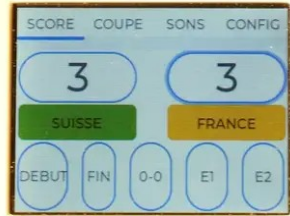
  - Adaptation for styling

What it contains / features*

- Scoring
- Colored items
- Teams selection
- Sounds
- Cups with different teams
- Use onboard led with color selection (already available)
- Screen backlight to preserve battery
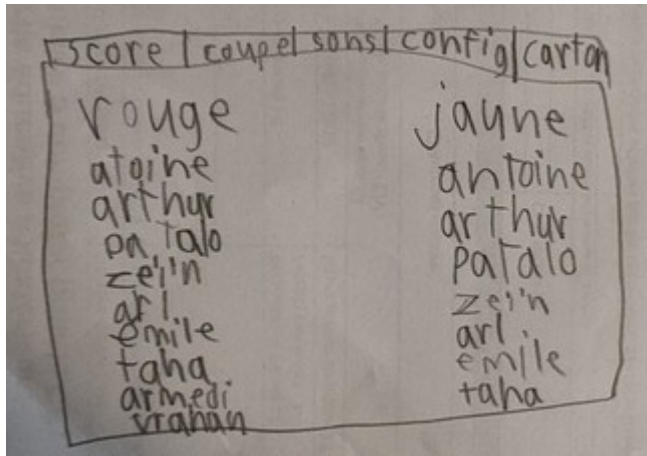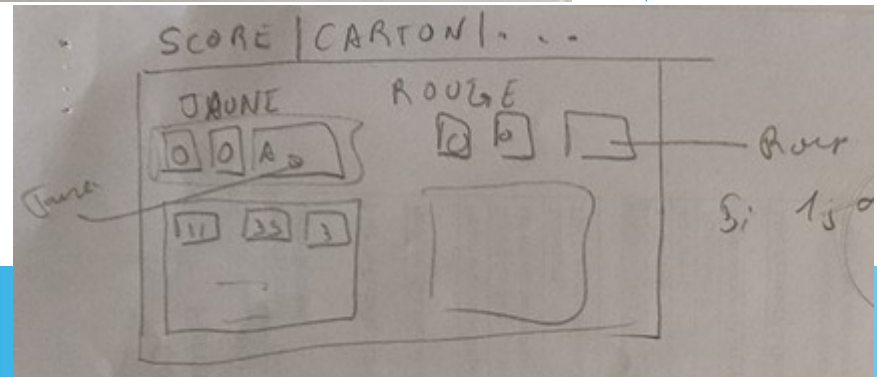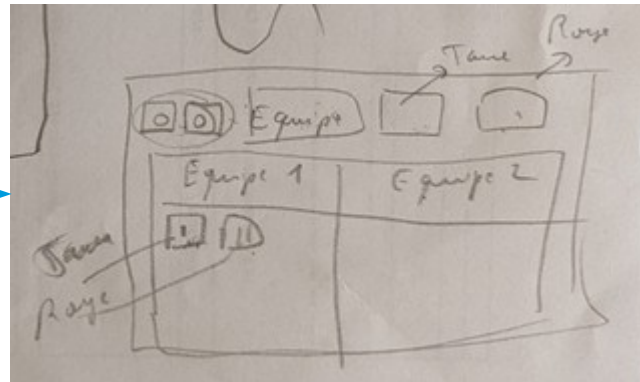- Store settings

DEMO

DEMO

On september for one month, addition of Yellow and Red Cards

Work with my kid on design

Challenge

- Use LVGL to display exactly at a screen position

- No borders to optimize screen space

- Remember the code structure

- Store settings into non volatile memory

Samples

What I learned

- LVGL library for embedded device is simple and easy to use
- C++ is not as simple as I was aware
  - Random seeds
  - ESP Libraries modified by Espressif
  - Memories on C and C++ with #IFDEF to handle same code
  - ESP IDF make many under actions on compilation
- Final code is not optimal or even maintenable for a real product
  - **THIS IS A TOY !**
- Not able to fix: Remove some margins and borders

The End

GitHub: https://github.com/jingl3s/nsec-badge-display-other