

How to make an appliance Pay as You Go (PAYG) using OpenPAYGO Token

General Case

General steps to make any appliance PAYG

- Open the device to access the PCB (circuit board)
- Find a place where you can plug the relay, it must fill the following characteristics:
 - o If the line is cut, the device shouldn't be usable. A good choice is often an internal wire going from the power connector to the PCB or going from the main PCB to some key element (e.g. motor for a pump, LCD for a TV, speaker for a speaker, etc.)
 - o It should be able to power the Arduino (5V – 12V for Arduino pro mini), if necessary, a power converter can be added to convert to the arduino voltage.
- Use the positive line to:
 - o Open or close the device with the relay
 - o Power the Arduino device (with the GND line as well)
- Use the negative line to:
 - o Power the Arduino device (with the positive line as well)

Connections

- **Interface connection:**
 - o Depends on the interface you choose, see the "Documentation of the Arduino Hardware Configurations" for more details about the different options (IR Remote, USB Keypad, etc.).
- **Relay connection:**
 - o IN RELAY -> D10 ARDUINO (ACTIVATION_PIN)
 - o GND RELAY -> GND ARDUINO
 - o VCC RELAY -> 5V ARDUINO
- **PAYG device connection (to power the Arduino):**
 - o VIN DEVICE -> VIN ARDUINO

- o GND DEVICE -> GND ARDUINO

Few tips

- When you choose the relay, make sure:
 - o It has a 5V nominal voltage so that it fits the Arduino 5V output
 - o The current it can provide is enough for the appliance you want to make PAYG
- Most of the time, you have to choose between Normally closed and Normally Opened output for the relay, I recommend to use the Normally Opened output so that if there is an issue with the Arduino management, the user can use the device (otherwise, the user might have paid but still be unable to use the device)

Concrete Example: TV

Getting Started

For the software, we use the following parameters:

- Membrane keypad interface
- Arduino Time management
- Add time (though it's not relevant here)
- TIME_DIVIDER = 255 (for test purposes, but not relevant here)

One example

- Link to relay: [here](#)
- Link to Membrane Keypad: [here](#)

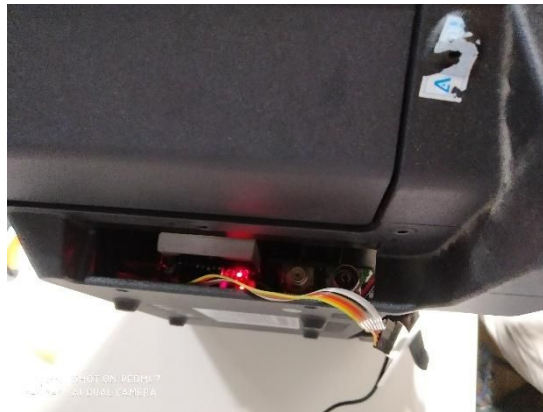
System Detail



The TV with the membrane keypad attached



The TV with the logo when the PAYG is ON



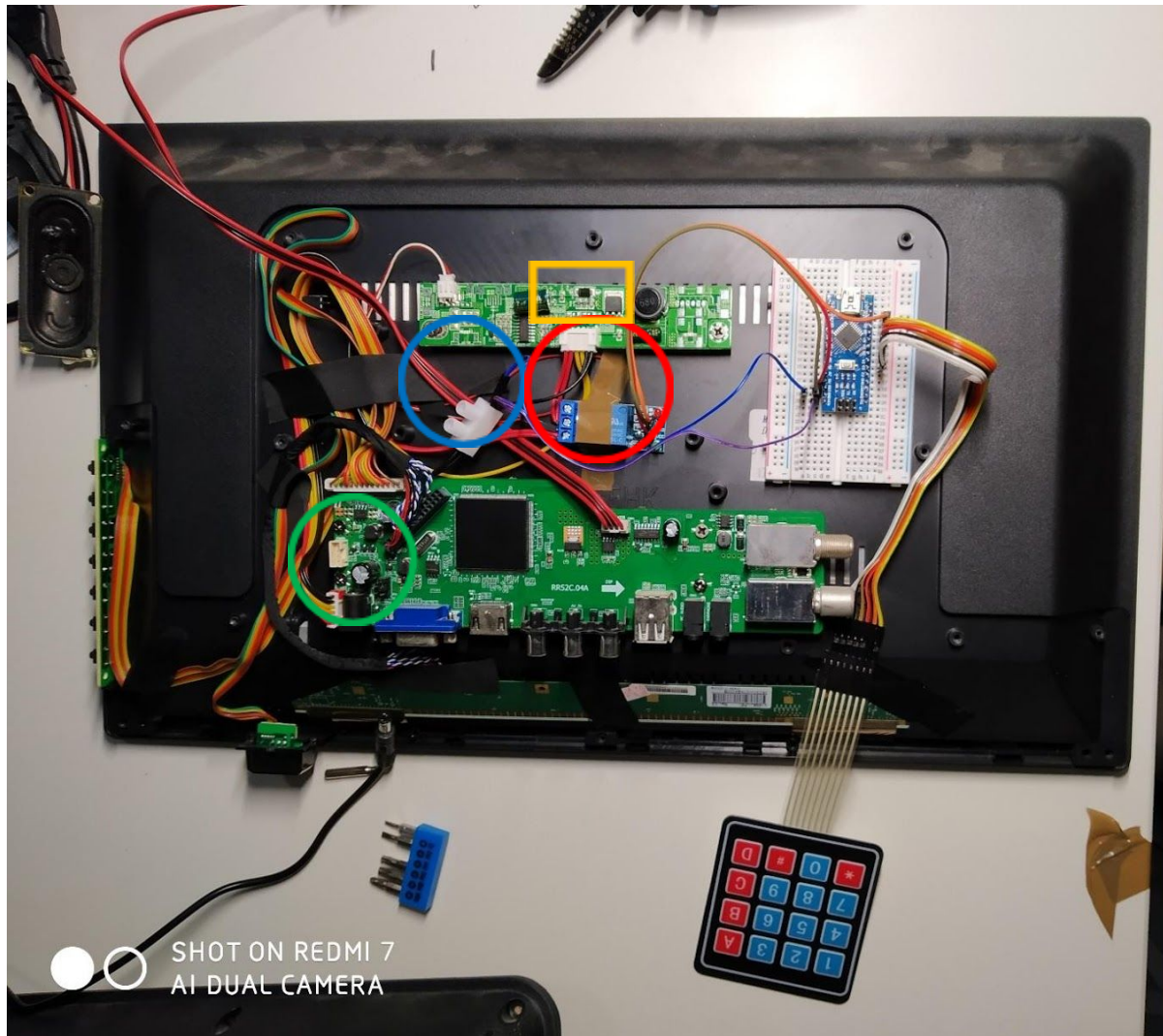
Inside of the PCB on the TV.

Looking at it makes the feedback (LED blinking) easier when you enter a token



The membrane keypad goes out of the PCB and is easily accessible for the user

PCB Overview



PCB Analysis and choice of relay connection target

You can notice two main PCBs:

- The top one is the one responsible for the screen lighting (and for power management), so I looked for the power connection between the bottom one, where the 12V DC power input is located (green circle) and the top one.
- I found these 6 wires (orange rectangle around one of the connectors):
 - o 2 red
 - o 2 yellow
 - o 2 black
- The red and black are the phase (12V) and ground. The yellow ones are at 6V, probably sent to send back power from top circuit to bottom circuit (red circle)

Steps taken to make the TV PAYG

- Cut the red wires and made them go through the relay
- Cut the black wires and made them go through a domino to be able to plug the Arduino GND to it (blue circle)
- Connect the interface (here the flexible keypad) to the Arduino following the interface connection documentation
- Run tests to make sure it was working properly, from the last section describing tests in the “Example Hardware Implementation Documentation”.
- The TV is now PAYG!