

# Barcelona Technological Institute

## Synthesis Work



+



### *Smart Waste: A solution to waste*

*Students: Richard Yabrudny, Nahuel Rios  
Hamza Tayibi and Joel Toullot.*

*Tutor: Fernando Rivero*

*Course: 2nd SMX*

*Class: C*

---

*"The longest journey begins with a first step."*

***Chinese proverb***

*"I used to think that great projects were done by great people, and now I realize that great projects make great people."*

***Anonymous***

---

*This section is designed to remind us that every small step we take brings us closer to great achievements. The quotes inspire to begin, to move forward and to grow through the challenges we encounter along the way.*

*What are your words of motivation on our journey towards creating a more sustainable world with the "Smart Waste" project...*

*Furthermore, we are enormously grateful for this opportunity to develop and to develop us as a group, project and people. We will do our best to deliver a masterful work in the eyes of society, surpassing our people from the past...*

*We hope you like it...*

*~ Richard, Hamza, Joel and Nahuel.~*

|  |           |
|--|-----------|
| <b>1. What is SmartWaste?.....</b>   | <b>4</b>  |
| 1.1 Problem description.....   | 5         |
| 1.2 How does it work?.....   | 6         |
| 1.3 Project benefits.....  | 7         |
| <b>2. Project development.....</b>   | <b>8</b>  |
| 2.1 LAMP package installation + Deployment.....                              | 9         |
| 2.2 Raspberry PI configuration (pending).....                                | 11        |
| 2.3 RaspberryPi: Second stage, OpenCV installation and code programming..... | 12        |
| <b>2.4 Our Website.....</b>  | <b>21</b> |
| Websites permissions.....  | 21        |
| DNS Configuration.....   | 22        |
| Apache configuration.....  | 23        |
| Result.....  | 25        |

## 1. What is SmartWaste?

---

*“SmartWaste: Automation of Waste Management”*

**SmartWaste** is an innovative project that seeks to revolutionize waste management through the use of advanced technologies such as computer vision and artificial intelligence. Our main objective is to automate the waste identification and classification process, which will allow for more efficient and sustainable waste management.

The project **SmartWaste** It is based on the idea of using devices such as the Raspberry Pi, equipped with cameras and specialized software, to scan and recognize the different types of waste that pass through a collection or classification system. Using machine learning algorithms, SmartWaste is able to distinguish between various materials such as plastic, paper, glass, metal, among others, thus facilitating their subsequent processing and recycling.

Once identified, waste can be automatically directed to the corresponding containers, optimizing the separation process and reducing contamination and the amount of non-recyclable waste. Besides, **SmartWaste** offers the possibility of collecting real-time data on the composition and flow of waste, allowing responsible authorities and organizations to make more informed and effective waste management decisions.



In summary, **SmartWaste** represents a significant advance in waste management, offering an innovative and technological solution to address current challenges in this field and promoting a more sustainable and responsible approach towards the management of our resources and care for the environment.

### 1.1 Description of the problem

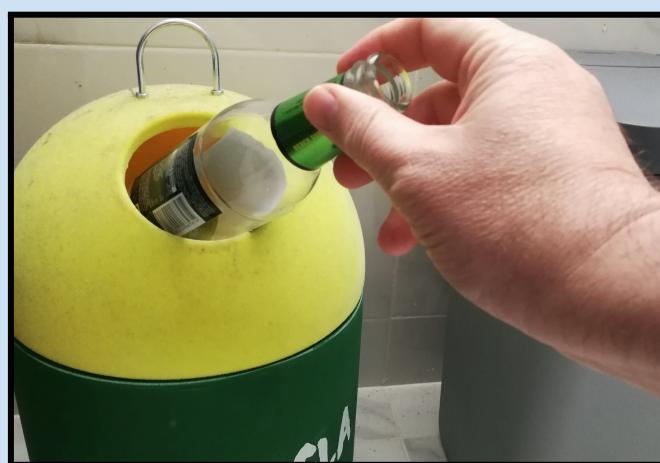
---

---

Waste management is an increasingly urgent challenge in modern society. With the increase in population and consumption, waste generation has reached alarming levels, posing a series of environmental, social and economic problems.

One of the main problems associated with waste management is the **inefficiency in the collection, classification and final disposal process**. In many places, waste sorting is done manually, resulting in low accuracy and a high rate of non-recyclable waste.

This not only leads to further pollution and environmental degradation, but also represents a waste of valuable resources that could be recovered and reused.



Furthermore, inadequate waste management can have serious repercussions on public health, especially in communities near landfills or areas with high levels of contamination. The accumulation of untreated waste also contributes to climate change by releasing greenhouse gases and pollutants into the atmosphere.

Another aspect of the problem is the lack of accurate and up-to-date data on the composition and flow of waste, which makes it difficult for authorities and organizations responsible for waste management to make informed decisions.

Demonstrating that inefficient waste management represents a multifaceted challenge that requires innovative and technological solutions to address its various dimensions, mitigating its negative impact on the environment and society.

## 1.2 How does it work?

---

In this section, we will explain how the project works:

---

1. SmartWaste will use cameras strategically located in waste collection areas to capture images of waste passing through the system, in the demonstration it will be located so that it is present in the circuit.
2. The captured images will be analyzed by computer vision algorithms, which will identify and classify automatically the different types of waste present in the images.
3. Based on the results of image processing, SmartWaste will automatically classify waste into categories such as plastic, paper, glass, metal, organic, among others, in the prototype; in early versions there will be fewer options to carry out the corresponding tests.



4. Once classified, SmartWaste will be able to take various actions according to the needs of the system, such as directing the waste to the corresponding containers or generating reports on the composition and flow of waste in real time.
5. SmartWaste is designed to learn and adapt over time, allowing you to continually improve your sorting algorithms and processes to increase accuracy and efficiency, this is a possible improvement for preview versions and we will take it into account.

With this technological and innovative approach, SmartWaste will be redefining waste management, offering a smart and sustainable solution to address current challenges in this field.

## **1.3 Project benefits**

---

SmartWaste is not only an innovative solution, but also offers a series of significant benefits that positively impact multiple aspects:

**1. Improved Efficiency:**

SmartWaste will automate the waste identification and classification process, resulting in more efficient and faster management compared to traditional manual methods.

**2. Reduction of Non-Recyclable Waste:**

Thanks to its ability to accurately distinguish between different types of waste, SmartWaste will help significantly reduce the amount of non-recyclable waste that ends up in landfills, thus promoting the circular economy and resource conservation.

**3. Promotion of Sustainable Practices:**

By facilitating the proper sorting and recycling of waste, SmartWaste will encourage sustainable practices at both the individual and community levels, raising awareness about the importance of responsible resource management and environmental protection.

**4. Environmental Improvement:**

By reducing the amount of non-recyclable waste and promoting sustainable practices, SmartWaste will contribute to the improvement of the environment by reducing pollution and conserving natural resources.



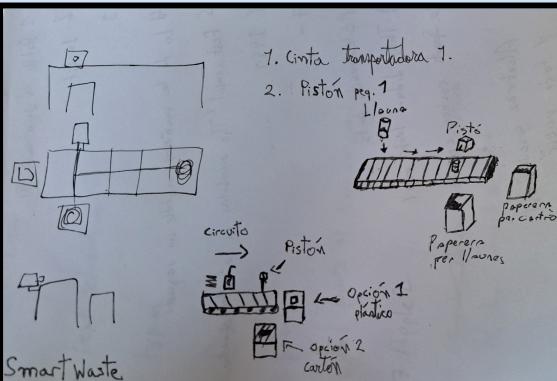
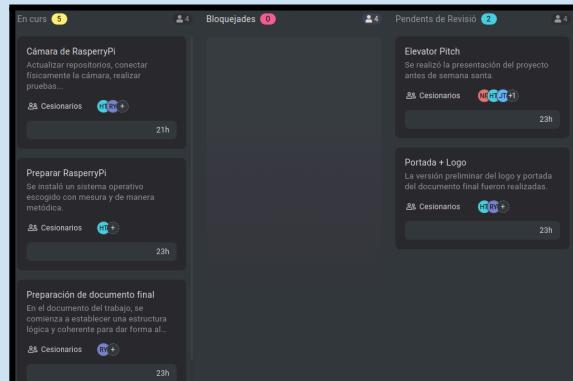
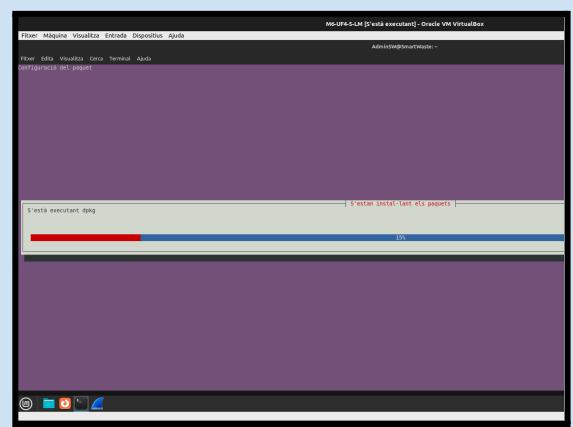
## 2. Project development

---

Now that we have explored the benefits and positive impact of SmartWaste, it is crucial to understand how the project developed, from conception to implementation.

In this section, the various aspects of SmartWaste development are explained, including the initial research and planning, the software and hardware development process, the tests and optimizations carried out, as well as the final project documentation.

To begin, the first days we were carrying out the **first sketches of the project**, and coordinating the group to **distribute the different tasks**, looking for the possible necessary materials.

|   |  |
|---|--|
|  <p>Sketches</p>  |  <p>Organization<br/>Proofhub</p> |
| <p>Raspberry Pi (93€ amb oferta (-40%)) (157,17€ sense oferta)<br/><a href="#">Link</a></p> <p>Càmera Raspberry Pi (12,95€)<br/><a href="#">Link</a></p> <p>Cintra transportadora (141,99 €)<br/><a href="#">Link</a></p> <p>Pistó per empènyer (9,07 € amb oferta (-32%)) (13,28 € sense oferta)<br/><a href="#">Link</a></p> <p>Cost total amb ofertes: 257,01 €<br/>Cost total sense ofertes: 325,39 €</p> |  <p>LAMP installation</p>        |

## 2.1 Installing the LAMP package + Deployment

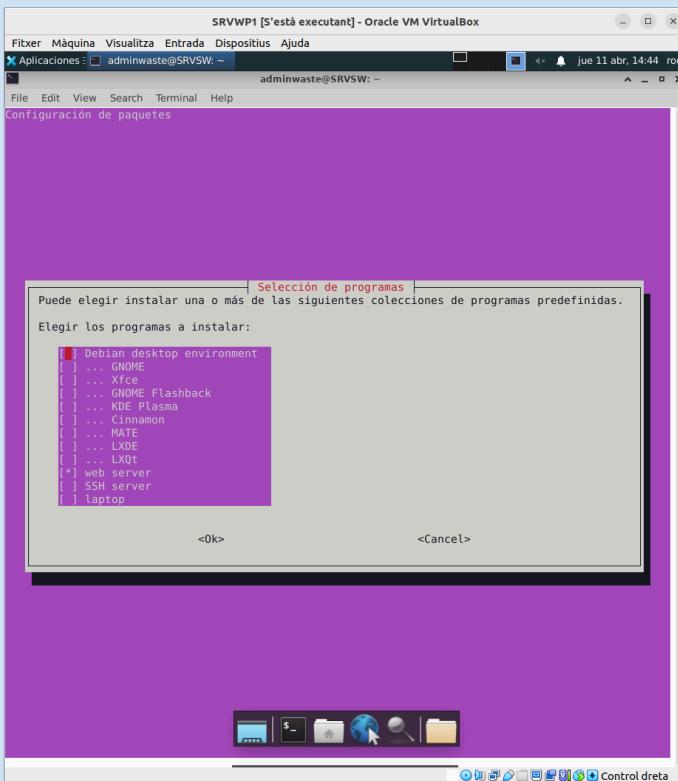
---

### Installation of LAMP package and Implementation steps:

**sudo apt update**

**sudo apt install taskel**

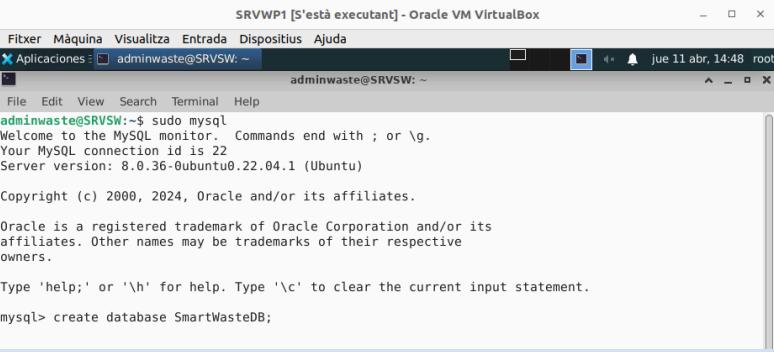
**sudo tasksel**



**sudo apt install mysql-server**

**sudo apt install php libapache2-mod-php**

**sudo apt install php-{curl,intl,zip,soap,xml,gd,mbstring,bcmath,common,mysqli}**



```

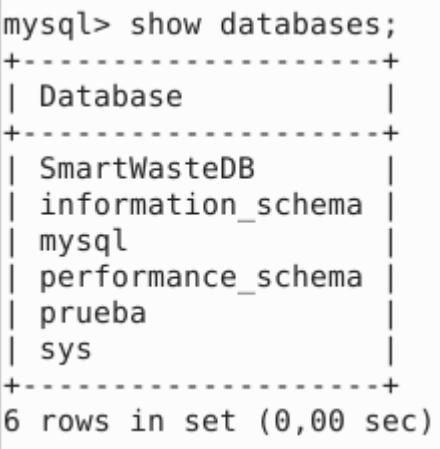
SRVWP1 [S'està executant] - Oracle VM VirtualBox
Fitxes Mànica Visualitzar Entrada Dispositius Ajuda
Aplicacions : adminwaste@SRVSW: ~
File Edit View Search Terminal Help
adminwaste@SRVSW:~$ sudo mysql
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 22
Server version: 8.0.36-0ubuntu0.22.04.1 (Ubuntu)

Copyright (c) 2000, 2024, Oracle and/or its affiliates.

Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> create database SmartWasteDB;

```

```

mysql> show databases;
+-----+
| Database |
+-----+
| SmartWasteDB |
| information_schema |
| mysql |
| performance_schema |
| prueba |
| sys |
+-----+
6 rows in set (0,00 sec)

```

**After creating our database, we unzip the WordPress installation file inside /var/www/html and after that we access the WordPress installation via <http://172.21.7.241/wordpress>.**

## 2.2 Raspberry PI setup (pending)

---

RaspberryPi OS 32 bits - Release 5.2 March 2024

### Raspberry Pi Initial Setup:

#### Hardware Preparation:

First, I made sure I had everything I needed: my **Raspberry Pi**, a card **microSD**, the **fountain of feeding**, and **keyboard**, and **mouse**, and **monitor** and the appropriate cables like my HDMI to vga adapter to connect it to the classroom monitor.

Next, I inserted the microSD card into the Raspberry Pi slot and connected all the peripheral devices.

#### Installation of the Operating System:

I downloaded the latest 32-bit Raspberry Pi OS image from the official Raspberry Pi website.

I used the balenaEtcher application on my computer to burn the operating system image on the microSD card.

#### Initial setup:

I inserted the microSD card into the Raspberry Pi and turned on the power.

I followed the instructions on the screen to complete the initial setup of the operating system, such as selecting the language, setting the password, and connecting to my Wi-Fi network.

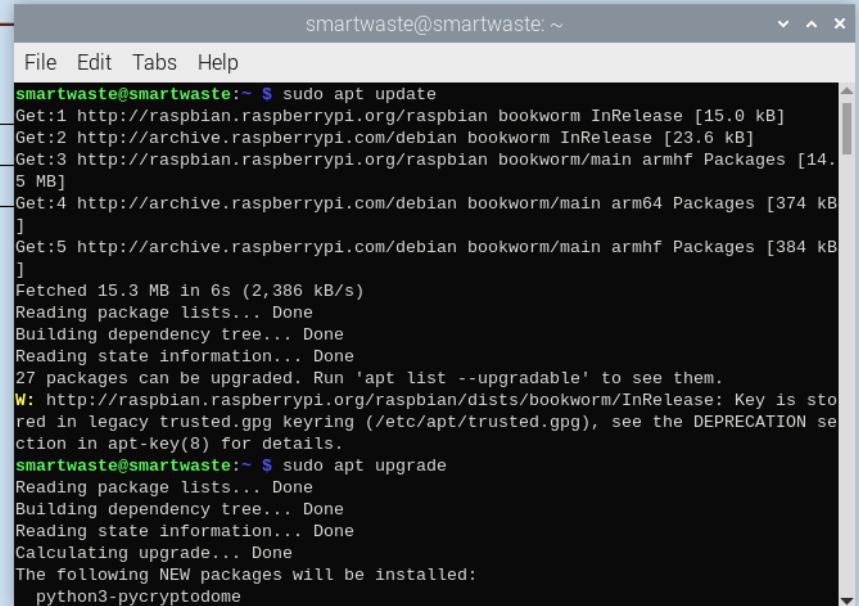
#### Upgrade system:

Once logged into my Raspberry Pi, I opened a terminal and ran the command `sudo apt update && sudo apt upgrade` to update all system packages to the latest available version.

## 2.3 RaspberryPi: Second stage, OpenCV installation and code programming.

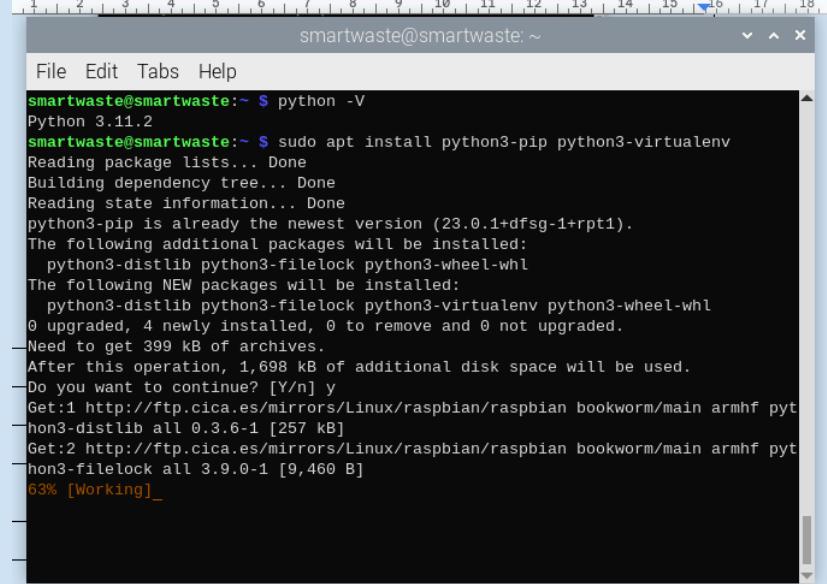
---

System upgrade and update:



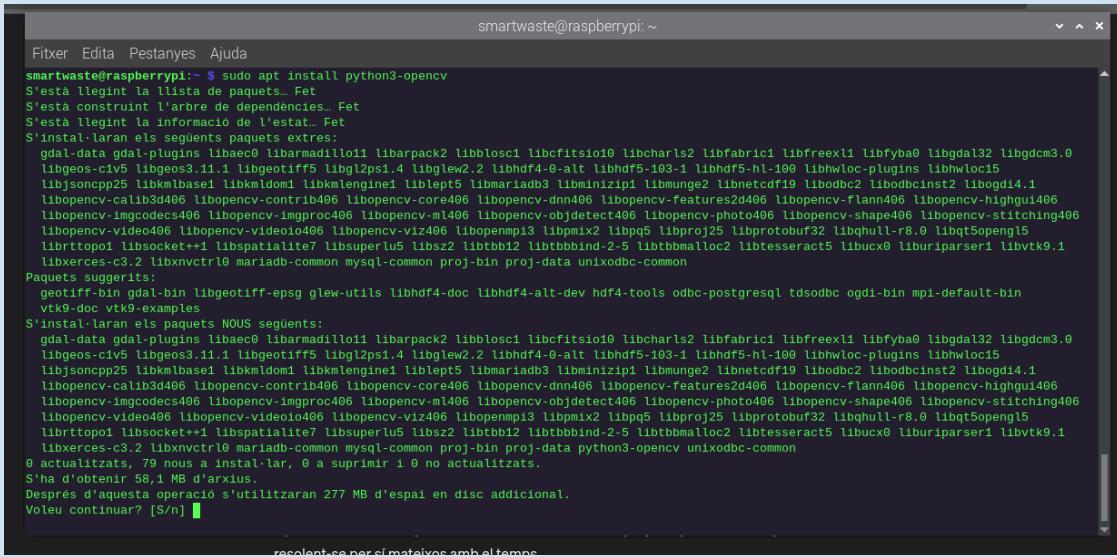
```
2.3 RaspberryPi. Segunda etapa
smartwaste@smartwaste: ~
File Edit Tabs Help
smartwaste@smartwaste:~ $ sudo apt update
Get:1 http://raspbian.raspberrypi.org/raspbian bookworm InRelease [15.0 kB]
Get:2 http://archive.raspberrypi.com/debian bookworm InRelease [23.6 kB]
Get:3 http://raspbian.raspberrypi.org/raspbian bookworm/main armhf Packages [14.5 MB]
Get:4 http://archive.raspberrypi.com/debian bookworm/main arm64 Packages [374 kB]
]
Get:5 http://archive.raspberrypi.com/debian bookworm/main armhf Packages [384 kB]
]
Fetched 15.3 MB in 6s (2,386 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
27 packages can be upgraded. Run 'apt list --upgradable' to see them.
W: http://raspbian.raspberrypi.org/raspbian/dists/bookworm/InRelease: Key is stored in legacy-trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPRECATION section in apt-key(8) for details.
smartwaste@smartwaste:~ $ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following NEW packages will be installed:
  python3-pycryptodome
```

View Python version and install necessary packages



```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
smartwaste@smartwaste: ~
File Edit Tabs Help
smartwaste@smartwaste:~ $ python -V
Python 3.11.2
smartwaste@smartwaste:~ $ sudo apt install python3-pip python3-virtualenv
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pip is already the newest version (23.0.1+dfsg-1+rpt1).
The following additional packages will be installed:
  python3-distlib python3-filelock python3-wheel-whl
The following NEW packages will be installed:
  python3-distlib python3-filelock python3-virtualenv python3-wheel-whl
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.
Need to get 399 kB of archives.
After this operation, 1,698 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://ftp.cica.es/mirrors/Linux/raspbian/raspbian bookworm/main armhf python3-distlib all 0.3.6-1 [257 kB]
Get:2 http://ftp.cica.es/mirrors/Linux/raspbian/raspbian bookworm/main armhf python3-filelock all 3.9.0-1 [9,460 B]
63% [Working]
```

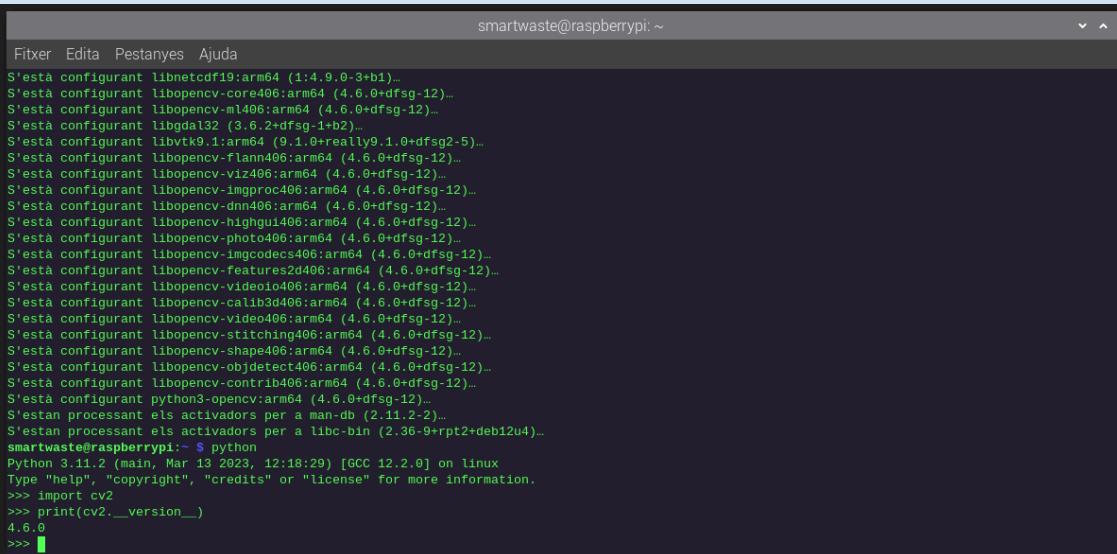
We install dependencies and OpenCV packages to be able to compile it on the RaspberryPi with Python.



```
smartwaste@raspberrypi:~$ sudo apt install python3-opencv
S'està llegint la llista de paquets... Fet
S'està construint l'arbre de dependències... Fet
S'està llegint la informació de l'estat... Fet
S'instal·laran els següents paquets exòtiques:
  gdal-data gdal-plugins libaec0 libarmadillo11 libarpack2 libbblosc1 libcfitsio10 libcharls2 libfabric1 libfreexl1 libfyba0 libgdal32 libgdcm3.0
  libgeos-c1v5 libgeos3.11.1 libgeotiff5 libgl2ps1.4 libglew2.2 libhdf4-0-alt libhdf5-103-1 libhdf5-hl-100 libhwloc-plugins libhwloc15
  libjsoncpp25 libkmlbase1 libkmldom1 libkmlengine1 liblept5 libmariaadb3 libminizip1 libmunge2 libmetcdf19 libodbc2 libodbcinst2 libogdi4.1
  libopencv-calib3d406 libopencv-contrib406 libopencv-core406 libopencv-dnn406 libopencv-features2d406 libopencv-flann406 libopencv-highgui406
  libopencv-imgcodecs406 libopencv-imgproc406 libopencv-m1406 libopencv-objectdetect406 libopencv-photo406 libopencv-shape406 libopencv-stitching406
  libopencv-video406 libopencv-videoio406 libopencv-viz406 libopenmp13 libpmix2 libpq5 libproj25 libprotobuf32 libqhull-7.8.0 libqt5opengl5
  librttopo1 libsocket+1 libspatialite7 libsuperlu5 libsz2 libtbdb12 libtbbmalloc2 libtesseract5 libucx0 liburiparser1 libvtk9.1
  libxerces-c3.2 libxml2 mariadb-common mysql-common proj-bin proj-data unixodbc-common
Paquets suggerits:
  geotiff-bin gdal-bin libgeotiff-epsg glew-utils libhdf4-doc libhdf4-0-alt-dev hdf4-tools odbc-postgresql tdsodbc ogdi-bin mpi-default-bin
  vtk9-doc vtk9-examples
S'instal·laran els paquets NOUS següents:
  gdal-data gdal-plugins libaec0 libarmadillo11 libarpack2 libbblosc1 libcfitsio10 libcharls2 libfabric1 libfreexl1 libfyba0 libgdal32 libgdcm3.0
  libgeos-c1v5 libgeos3.11.1 libgeotiff5 libgl2ps1.4 libglew2.2 libhdf4-0-alt libhdf5-103-1 libhdf5-hl-100 libhwloc-plugins libhwloc15
  libjsoncpp25 libkmlbase1 libkmldom1 libkmlengine1 liblept5 libmariaadb3 libminizip1 libmunge2 libmetcdf19 libodbc2 libodbcinst2 libogdi4.1
  libopencv-calib3d406 libopencv-contrib406 libopencv-core406 libopencv-dnn406 libopencv-features2d406 libopencv-flann406 libopencv-highgui406
  libopencv-imgcodecs406 libopencv-imgproc406 libopencv-m1406 libopencv-objectdetect406 libopencv-photo406 libopencv-shape406 libopencv-stitching406
  libopencv-video406 libopencv-videoio406 libopencv-viz406 libopenmp13 libpmix2 libpq5 libproj25 libprotobuf32 libqhull-7.8.0 libqt5opengl5
  librttopo1 libsocket+1 libspatialite7 libsuperlu5 libsz2 libtbdb12 libtbbmalloc2 libtesseract5 libucx0 liburiparser1 libvtk9.1
  libxerces-c3.2 libxml2 mariadb-common mysql-common proj-bin proj-data python3-opencv unixodbc-common
0 actualitzats, 79 nous a instal·lar, 0 a suprimir i 0 no actualitzats.
S'ha d'obtenir 58.1 MB d'arxius.
Després d'aquesta operació s'utilitzaran 277 MB d'espai en disc addicional.
Voleu continuar? [S/n] ■
```

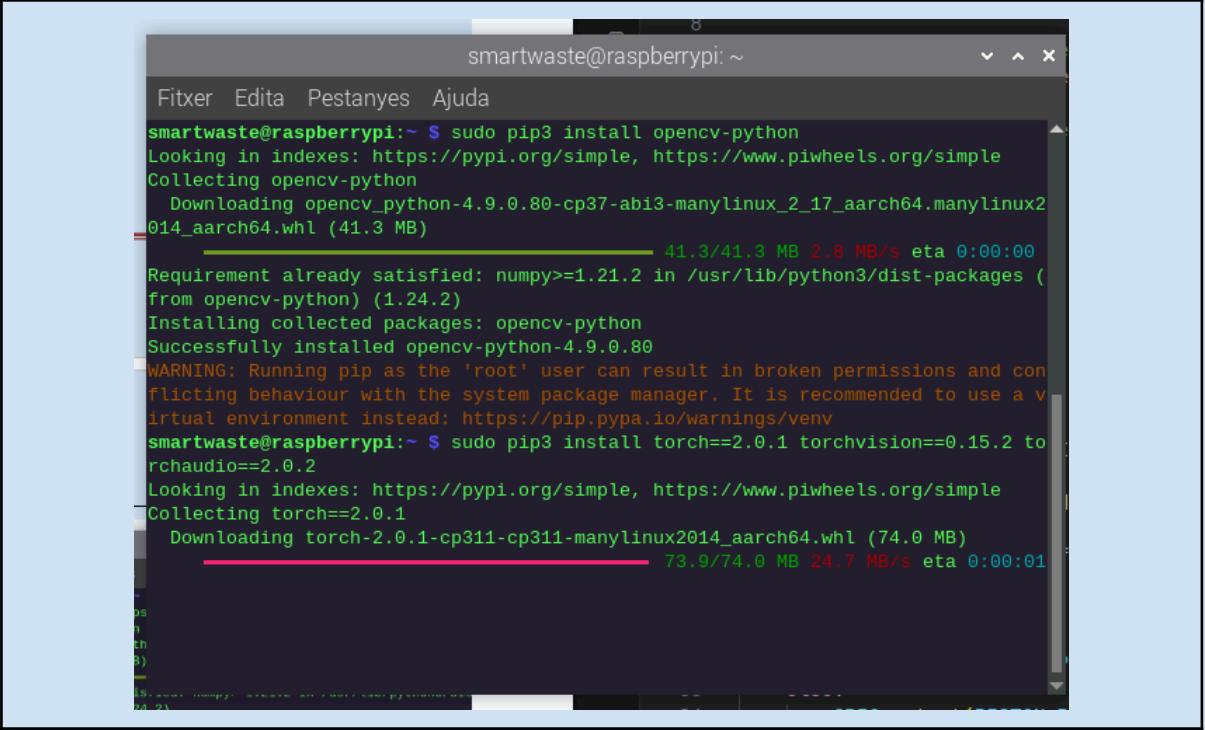
resolent-se per si mateixos amb el temps.

Check and import OpenCV in Python and install visual studio code.



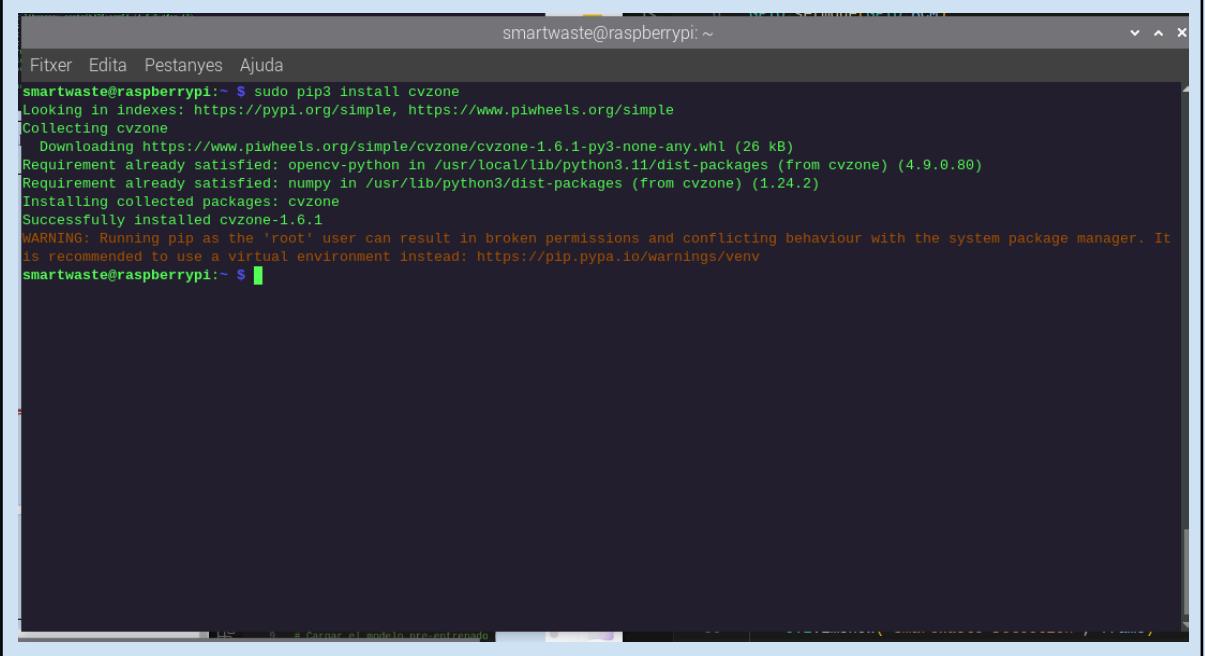
```
smartwaste@raspberrypi:~$ smartwaste@raspberrypi:~$ sudo apt install python3-opencv
S'està configurant libnetcdf19:arm64 (1:4.9.0-3+b1)...
S'està configurant libopencv-core406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-m1406:arm64 (4.6.0+dfsg-12)...
S'està configurant libgdal32 (3.6.2+dfsg-1+b2)...
S'està configurant libvtk9.1:arm64 (9.1.0+really9.1.0+dfsg2-5)...
S'està configurant libopencv-flann406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-viz406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-imgproc406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-highgui406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-photo406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-imgcodecs406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-features2d406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-videoio406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-callb3d406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-video406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-stitching406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-shape406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-objectdetect406:arm64 (4.6.0+dfsg-12)...
S'està configurant libopencv-contrib406:arm64 (4.6.0+dfsg-12)...
S'està configurant python3-opencv:arm64 (4.6.0+dfsg-12)...
S'estan processant els activadors per a un man-db (2.11.2-2)...
S'estan processant els activadors per a un libc-bin (2.36-9+rpt2+deb12u4)...
smartwaste@raspberrypi:~$ python
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import cv2
>>> print(cv2.__version__)
4.6.0
>>> ■
```

Now we install python with pip3, in order to avoid problems in the future, following very methodical steps.

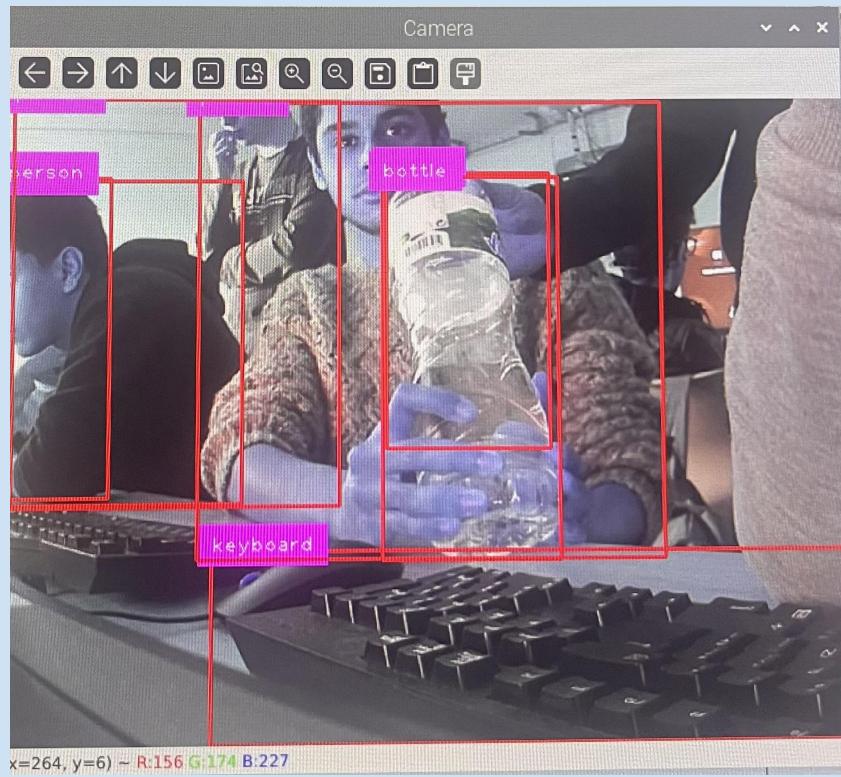


```
smartwaste@raspberrypi:~ $ sudo pip3 install opencv-python
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting opencv-python
  Downloading opencv_python-4.9.0.80-cp37-abi3-manylinux_2_17_aarch64.manylinux2
014_aarch64.whl (41.3 MB)
    ━━━━━━━━━━━━━━━━ 41.3/41.3 MB 2.8 MB/s eta 0:00:00
Requirement already satisfied: numpy>=1.21.2 in /usr/lib/python3/dist-packages (from opencv-python) (1.24.2)
Installing collected packages: opencv-python
Successfully installed opencv-python-4.9.0.80
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
smartwaste@raspberrypi:~ $ sudo pip3 install torch==2.0.1 torchvision==0.15.2 tor
rchaudio==2.0.2
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting torch==2.0.1
  Downloading torch-2.0.1-cp311-cp311-manylinux2014_aarch64.whl (74.0 MB)
    ━━━━━━━━━━━━━━━━ 73.9/74.0 MB 24.7 MB/s eta 0:00:01
os
n
3)
L

```

```
smartwaste@raspberrypi:~ $ sudo pip3 install cvzone
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting cvzone
  Downloading https://www.piwheels.org/simple/cvzone/cvzone-1.6.1-py3-none-any.whl (26 kB)
Requirement already satisfied: opencv-python in /usr/local/lib/python3.11/dist-packages (from cvzone) (4.9.0.80)
Requirement already satisfied: numpy in /usr/lib/python3/dist-packages (from cvzone) (1.24.2)
Installing collected packages: cvzone
Successfully installed cvzone-1.6.1
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
smartwaste@raspberrypi:~ $
```



Program with Python, first recognition tests.

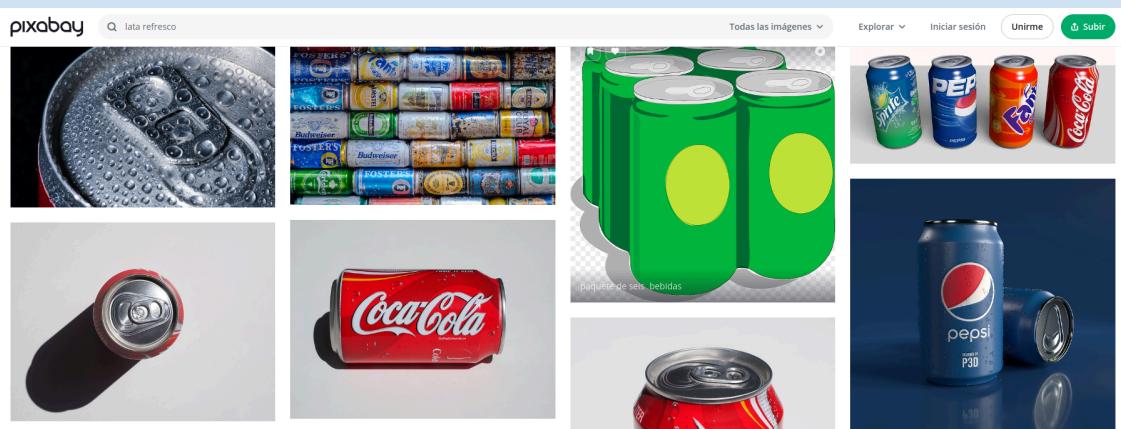


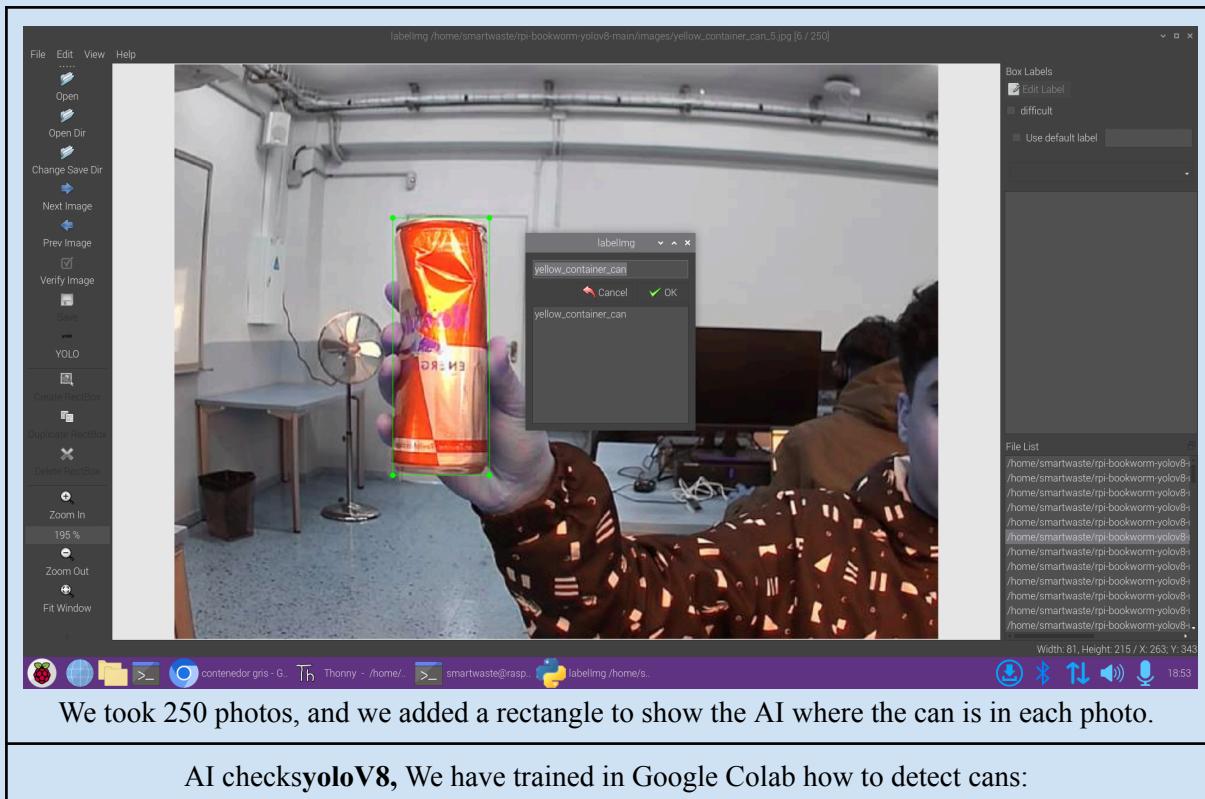
Image bank, we will try to train the AI with these if it becomes necessary.

Installation of necessary and important tools

```
P smartwaste@raspberrypi: ~
P Fitxer Edita Pestanyes Ajuda
s smartwaste@raspberrypi:~ $ sudo apt-get install pyqt5-dev-tools
[s'està llegint la llista de paquets... Fet
[S'està construint l'arbre de dependències... Fet
c S'està llegint la informació de l'estat... Fet
S'instal·laran els paquets NOUS següents:
G pyqt5-dev-tools
0 actualitzats, 1 nous a instal·lar, 0 a suprimir i 19 no actualitzats.
C S'ha d'obtenir 177 kB d'arxius.
p Després d'aquesta operació s'utilitzaran 479 kB d'espai en disc addicional.
Bai:1 http://deb.debian.org/debian bookworm/main arm64 pyqt5-dev-tools arm64 5.1
V 5.9+dfsg-1 [177 kB]
L S'ha baixat 177 kB en 0s (1.307 kB/s)
S'està seleccionant el paquet pyqt5-dev-tools previament no seleccionat.
A(S'està llegint la base de dades... hi ha 130712 fitxers i directoris instal·lats
actualment.)
L S'està preparant per a desempaquetar .../pyqt5-dev-tools_5.15.9+dfsg-1_arm64.deb...
S'està desempaquetant pyqt5-dev-tools (5.15.9+dfsg-1)...
S'està configurant pyqt5-dev-tools (5.15.9+dfsg-1)...
T S'estan processant els activadors per a man-db (2.11.2-2)...
smartwaste@raspberrypi:~ $
```

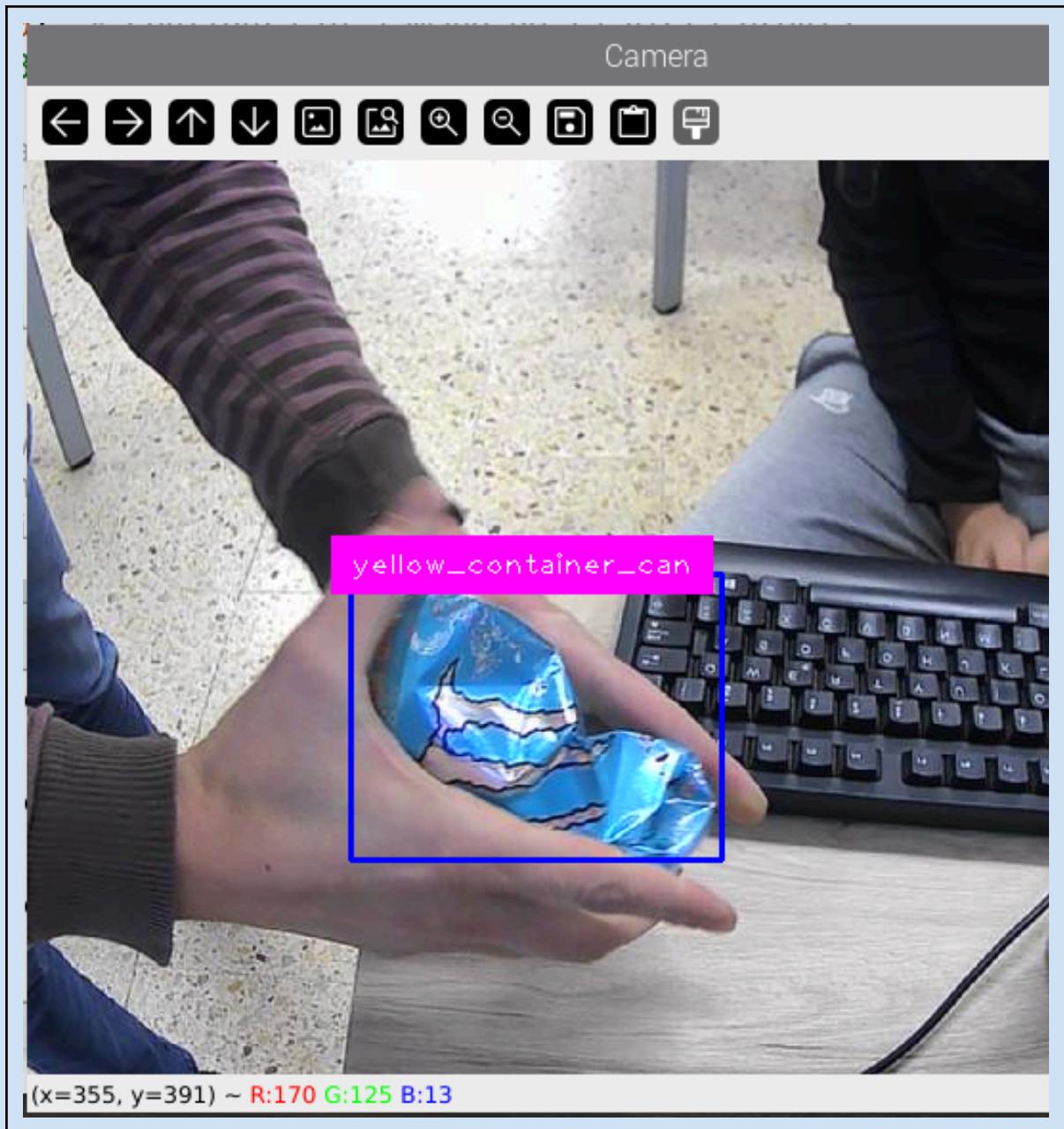
```
F smartwaste@raspberrypi: ~
Fitxer Edita Pestanyes Ajuda
(S'està llegint la base de dades... hi ha 130712 fitxers i directoris instal·lats
actualment.)
S'està preparant per a desempaquetar .../pyqt5-dev-tools_5.15.9+dfsg-1_arm64.deb...
S'està desempaquetant pyqt5-dev-tools (5.15.9+dfsg-1)...
S'està configurant pyqt5-dev-tools (5.15.9+dfsg-1)...
S'estan processant els activadors per a man-db (2.11.2-2)...
smartwaste@raspberrypi:~ $ sudo pip3 install labelImg
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting labeling
  Downloading https://www.piwheels.org/simple/labelImg/labelImg-1.8.6-py2.py3-none-any.whl (265 kB)
    265.7/265.7 kB 1.6 MB/s eta 0:00:00
Requirement already satisfied: lxml in /usr/lib/python3/dist-packages (from labelImg) (4.9.2)
Requirement already satisfied: pyqt5 in /usr/lib/python3/dist-packages (from labelImg) (5.15.9)
Requirement already satisfied: PyQt5-sip<13,>=12.11 in /usr/lib/python3/dist-packages (from labelImg) (12.11.1)
Installing collected packages: labeling
  Successfully installed labeling-1.8.6
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
smartwaste@raspberrypi:~ $
```

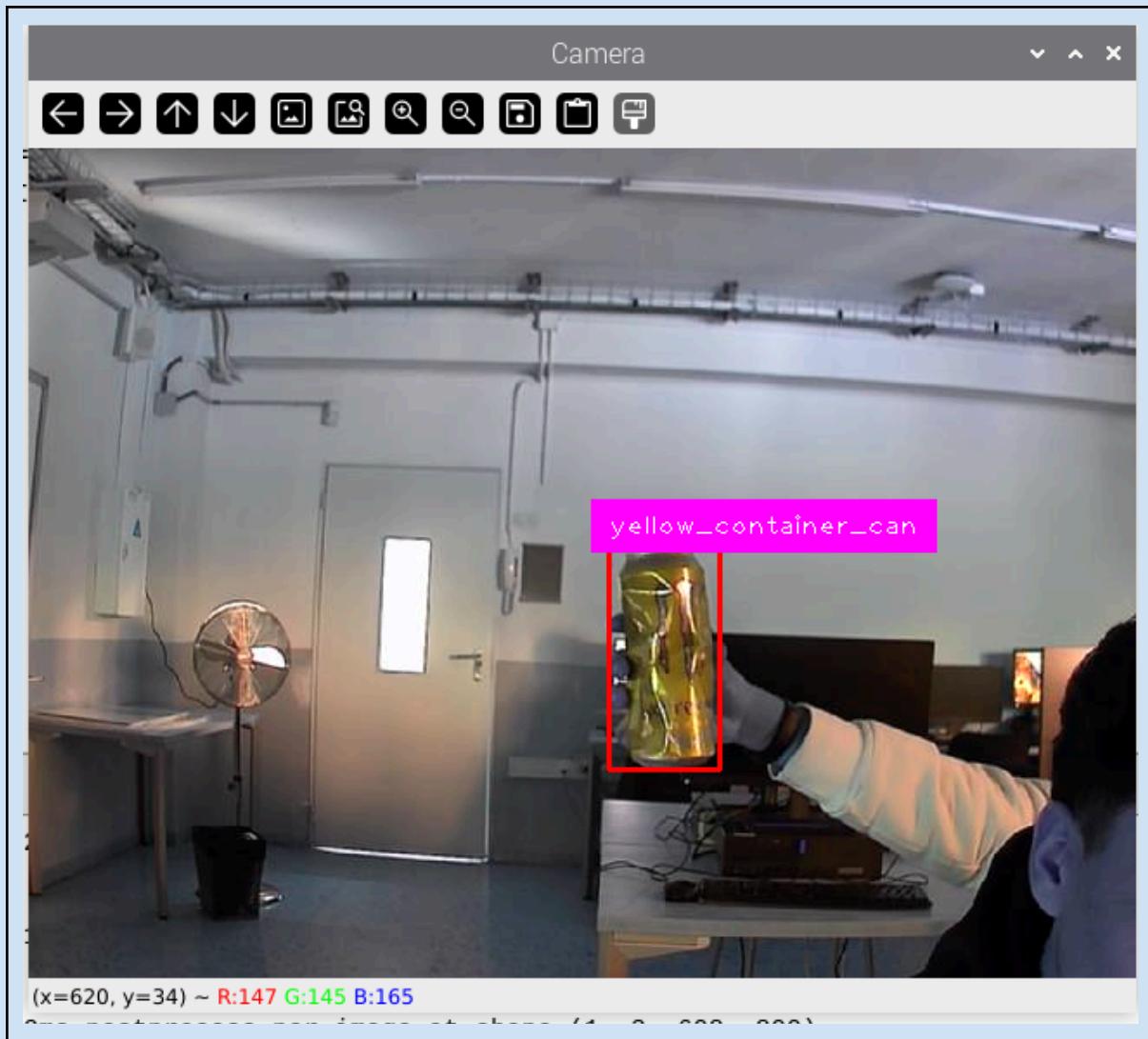
Phase 1 of image recognition: Add coordinates to each photo manually, to later transfer them to Google Colab, this with the program labelImg

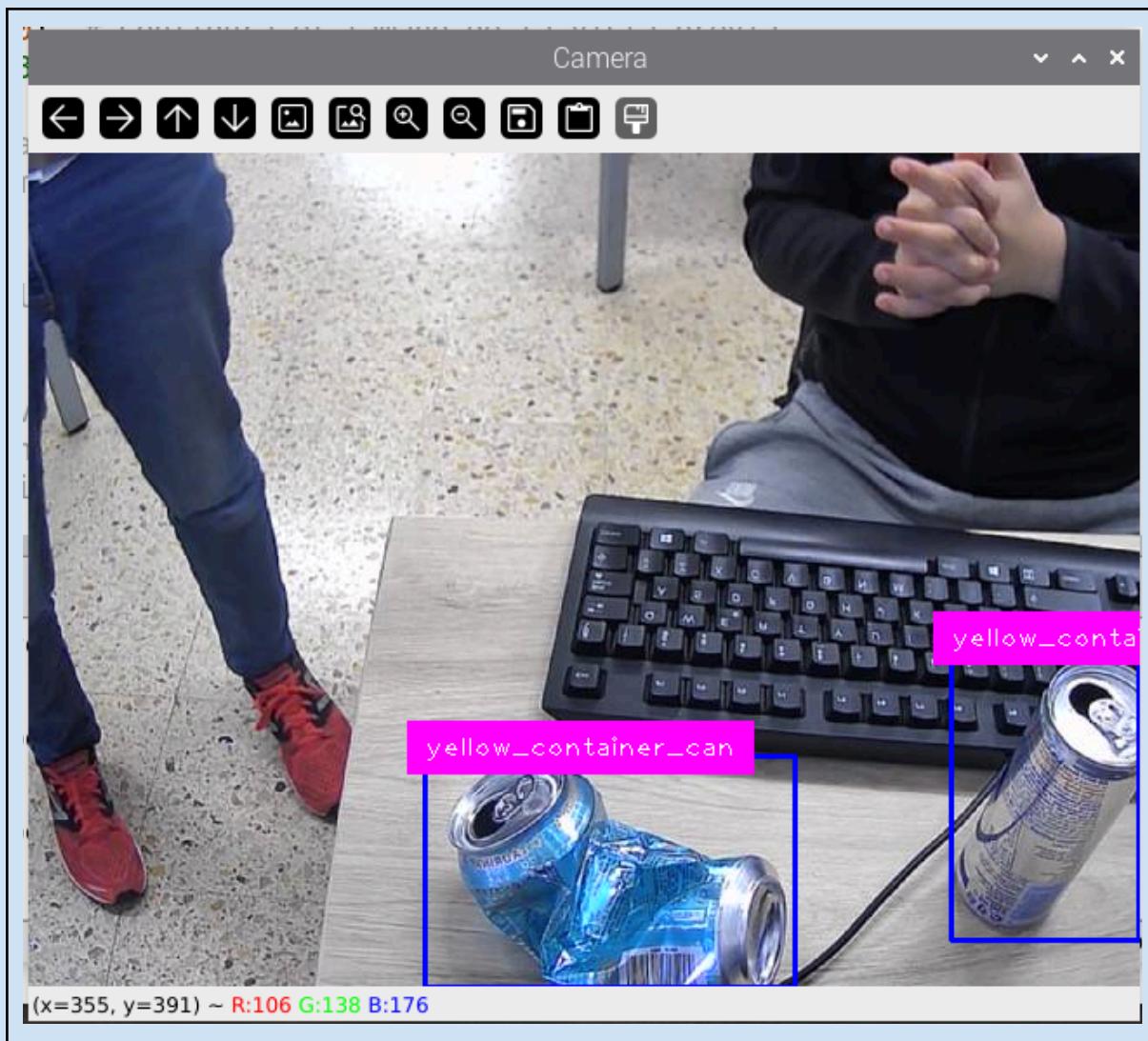


We took 250 photos, and we added a rectangle to show the AI where the can is in each photo.

AI checks **yoloV8**, We have trained in Google Colab how to detect cans:







## 2.4 Our Website

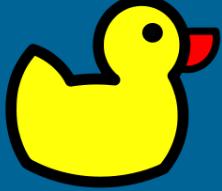
---

### Websites permissions

```
adminwaste@SRVSW:/var/www/html$ ls -l
total 232
-rw-r--r-- 1 www-data www-data 405 feb 6 2020 index.php
-rw-r--r-- 1 www-data www-data 19915 abr 9 17:16 license.txt
-rw-r--r-- 1 www-data www-data 7401 abr 10 13:32 readme.html
-rw-r--r-- 1 www-data www-data 7387 abr 9 17:16 wp-activate.php
drwxr-xr-x 9 www-data www-data 4096 mar 17 09:00 wp-admin
-rw-r--r-- 1 www-data www-data 351 feb 6 2020 wp-blog-header.php
-rw-r--r-- 1 www-data www-data 2323 jun 14 2023 wp-comments-post.php
-rw-r--r-- 1 www-data www-data 3561 abr 9 17:12 wp-config.php
-rw-r--r-- 1 www-data www-data 3012 abr 9 17:16 wp-config-sample.php
drwxr-xr-x 7 www-data www-data 4096 abr 25 14:30 wp-content
-rw-r--r-- 1 www-data www-data 5638 may 30 2023 wp-cron.php
drwxr-xr-x 30 www-data www-data 12288 abr 9 17:16 wp-includes
-rw-r--r-- 1 www-data www-data 2502 nov 26 2022 wp-links-opml.php
-rw-r--r-- 1 www-data www-data 3927 jul 16 2023 wp-load.php
-rw-r--r-- 1 www-data www-data 50917 abr 9 17:16 wp-login.php
-rw-r--r-- 1 www-data www-data 8525 sep 16 2023 wp-mail.php
-rw-r--r-- 1 www-data www-data 28427 abr 9 17:16 wp-settings.php
-rw-r--r-- 1 www-data www-data 34385 jun 19 2023 wp-signup.php
-rw-r--r-- 1 www-data www-data 4885 jun 22 2023 wp-trackback.php
-rw-r--r-- 1 www-data www-data 3246 abr 9 17:16 xmlrpc.php
```

These are the website permissions that are as restricted as possible while still being able to access the website and administrate it.

## DNS Configuration



### Duck DNS

account smartwasteit@gmail.com  
type free  
token f6f26407-274d-4557-935c-1b31ecec0907  
token generated 1 minute ago  
created date 25 Apr 2024, 14:02:01

domains 1/5

| domain        | current ip                              | ipv6   | changed                                       |
|---------------|---|--|---|
| smartwaste-es | 172.21.7.241 <button>update ip</button> | <input type="text" value="ipv6 address"/> <button>update ipv6</button> | 57 seconds ago <button>delete domain</button> |

This site is protected by reCAPTCHA and the Google [Privacy Policy](#) and [Terms of Service](#) apply.

We used Duck DNS for the configuration of the DNS which allow us to create domains based with our IP (172.21.7.241)

## Apache configuration

The image shows two side-by-side screenshots of the Geany text editor. Both windows have the title "SmartWaste.conf - /etc/apache2/sites-available - Geany". The top window (lines 1-38) contains the initial configuration for a virtual host named "www.SmartWaste.es". It includes directives for SSL (mod\_ssl.c), log levels, error logs, and access logs. The bottom window (lines 37-74) continues the configuration, focusing on SSL certificate management. It specifies paths for self-signed certificates ("ssl-cert"), certificate chains ("SSLCertificateChainFile"), and certificate authorities ("SSLCACertificatePath"). It also defines paths for CA revocation lists ("SSLCARevocationPath") and client authentication ("SSLVerifyClient require"). Both windows have a toolbar at the top with standard file operations like Open, Save, Cut, Copy, Paste, and Undo/Redo.

```
<IfModule mod_ssl.c>
<VirtualHost _default_:443>
    ServerName www.SmartWaste.es
    ServerAdmin webmaster@SmartWaste.conf
    DocumentRoot /var/www/html
    DirectoryIndex index.php

    # Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
    # error, crit, alert, emerg.
    # It is also possible to configure the loglevel for particular
    # modules, e.g.
    #LogLevel info ssl:warn

    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined

    # For most configuration files from conf-available/, which are
    # enabled or disabled at a global level, it is possible to
    # include a line for only one particular virtual host. For example the
    # following line enables the CGI configuration for this host only
    # after it has been globally disabled with "a2disconf".
    #Include conf-available/serve-cgi-bin.conf

    # SSL Engine Switch:
    # Enable/Disable SSL for this virtual host.
    SSLEngine on

    # A self-signed (snakeoil) certificate can be created by installing
    # the ssl-cert package. See
    # /usr/share/doc/apache2/README.Debian.gz for more info.
    # If both key and certificate are stored in the same file, only the
    # SSLCertificateFile directive is needed.
    SSLCertificateFile /etc/apache2/ssl/certificate.pem
    #SSLCertificateKeyFile /etc/ssl/private/ssl-cert-snakeoil.key

    # Server Certificate Chain:
    # Point SSLCertificateChainFile at a file containing the
    # concatenation of PEM encoded CA certificates which form the

```

```
# Point SSLCertificateChainFile at a file containing the
# concatenation of PEM encoded CA certificates which form the
# certificate chain for the server certificate. Alternatively
# the referenced file can be the same as SSLCertificateFile
# when the CA certificates are directly appended to the server
# certificate for convinience.
#SSLCertificateChainFile /etc/apache2/ssl.crt/ca-bundle.crt
#SSLCertificateChainFile /etc/apache2/ssl.crt/server-ca.crt

# Certificate Authority (CA):
# Set the CA certificate verification path where to find CA
# certificates for client authentication or alternatively one
# huge file containing all of them (file must be PEM encoded)
# Note: Inside SSLCACertificatePath you need hash symlinks
# to point to the certificate files. Use the provided
# Makefile to update the hash symlinks after changes.
#SSLCACertificatePath /etc/ssl/certs/
#SSLCACertificateFile /etc/apache2/ssl.crt/ca-bundle.crt

# Certificate Revocation Lists (CRL):
# Set the CA revocation path where to find CA CRLs for client
# authentication or alternatively one huge file containing all
# of them (file must be PEM encoded)
# Note: Inside SSLCARevocationPath you need hash symlinks
# to point to the certificate files. Use the provided
# Makefile to update the hash symlinks after changes.
#SSLCARevocationPath /etc/apache2/ssl.crl/
#SSLCARevocationFile /etc/apache2/ssl.crl/ca-bundle.crl

# Client Authentication (Type):
# Client certificate verification type and depth. Types are
# none, optional, require and optional_no_ca. Depth is a
# number which specifies how deeply to verify the certificate
# issuer chain before deciding the certificate is not valid.
#SSLVerifyClient require
#SSLVerifyDepth 10

# SSL Engine Options:
```

SmartWaste.conf - /etc/apache2/sites-available - Geany

```

Archivo Editar Buscar Ver Documento Proyecto Construir Herramientas Ayuda
Símbolos SmartWaste.conf x
No se han encontrado símbolos.
75      # Set various options for the SSL engine.
76      # o FakeBasicAuth:
77      # Translate the client X.509 into a Basic Authorisation. This means that
78      # the standard Auth/DBMAuth methods can be used for access control. The
79      # user name is the 'one line' version of the client's X.509 certificate.
80      # Note that no password is obtained from the user. Every entry in the user
81      # file needs this password: 'xxj31ZMTZzkVA'.
82      # o ExportCertData:
83      # This exports two additional environment variables: SSL_CLIENT_CERT and
84      # SSL_SERVER_CERT. These contain the PEM-encoded certificates of the
85      # server (always existing) and the client (only existing when client
86      # authentication is used). This can be used to import the certificates
87      # into CGI scripts.
88      # o StdEnvVars:
89      # This exports the standard SSL/TLS related 'SSL_*' environment variables.
90      # Per default this exportation is switched off for performance reasons,
91      # because the extraction step is an expensive operation and is usually
92      # useless for serving static content. So one usually enables the
93      # exportation for CGI and SSI requests only.
94      # o OptRenegotiate:
95      # This enables optimized SSL connection renegotiation handling when SSL
96      # directives are used in per-directory context.
97      #SSLOptions +FakeBasicAuth +ExportCertData +StrictRequire
98      <FilesMatch "\.(cgi|shtml|phtml|php)$">
99          SSLOptions +StdEnvVars
100     </FilesMatch>
101     <Directory /usr/lib/cgi-bin>
102         SSLOptions +StdEnvVars
103     </Directory>
104
105     # SSL Protocol Adjustments:
106     # The safe and default but still SSL/TLS standard compliant shutdown
107     # approach is that mod_ssl sends the close notify alert but doesn't wait for
108     # the close notify alert from client. When you need a different shutdown
109     # approach you can use one of the following variables:
110     # o ssl-unclean-shutdown:
111     # This forces an unclean shutdown when the connection is closed, i.e. no
112     # SSL close notify alert is send or allowed to received. This violates
113     # the SSL/TLS standard but is needed for some brain-dead browsers. Use
114     # this when you receive I/O errors because of the standard approach where
115     # mod_ssl sends the close notify alert.
116     # o ssl-accurate-shutdown:
117     # This forces an accurate shutdown when the connection is closed, i.e. a
118     # SSL close notify alert is send and mod_ssl waits for the close notify
119     # alert of the client. This is 100% SSL/TLS standard compliant, but in
120     # practice often causes hanging connections with brain-dead browsers. Use
121     # this only for browsers where you know that their SSL implementation
122     # works correctly.
123     # Notice: Most problems of broken clients are also related to the HTTP
124     # keep-alive facility, so you usually additionally want to disable
125     # keep-alive for those clients, too. Use variable "nokeepalive" for this.
126     # Similarly, one has to force some clients to use HTTP/1.0 to workaround
127     # their broken HTTP/1.1 implementation. Use variables "downgrade-1.0" and
128     # "force-response-1.0" for this.
129     # BrowserMatch "MSIE [2-6]" \
130     #           nokeepalive ssl-unclean-shutdown \
131     #           downgrade-1.0 force-response-1.0
132
133     </VirtualHost>
134 </IfModule>
135
136
137 # vim: syntax=apache ts=4 sw=4 sts=4 sr noet

```

This is our Apache configuration to connect us to our website via HTTP and HTTPS

## Result

<http://smartwaste-es.duckdns.org/> (in order to enter the website, you'll have to be on the ITB's subnetwork).

For our home page, we wanted to do it with a video on the back and a big artwork by just entering the page. Then, we explain some of our enterprise, and added a inspirational phrase. Finally some pictures and an additional redirection to the other pages.

These are the screenshots of our home:





Trabajamos por un mundo en el que las personas puedan disfrutar de un futuro verde y en paz.

Cada pequeño paso que damos nos acerca a grandes logros. Las citas nos inspiran a comenzar, a seguir adelante y a crecer a través de los desafíos que encontramos en el camino.

SmartWaste es una empresa de filtrado de reciclaje, mediante una inteligencia artificial que reconoce el objeto colocado en frente de una cámara, y dictamina si es digna de reciclarse o no.

*"Más que una obligación, reciclar es una necesidad."*

**ANÓNIMO**



digna de reciclarse o no.

*"Más que una obligación, reciclar es una necesidad."*

**ANÓNIMO**



[¿Quiénes somos?](#)

[¿Qué hacemos?](#)

[Contacto](#)

© 2024 SMARTWASTE. Created for free using WordPress and Kubio

In the 'Who are we?' section, we got rid of the video on the top, and added a fade in the background. Then, we wrote a brief but detailed description of our company and our objectives, finally, an AI generated image.

This are the screenshots of the 'Who are we?' section:

The screenshot shows the 'Quiénes somos?' (Who are we?) page of the SmartWaste website. The header features the company logo 'SMARTWASTE' and navigation links for Home, Quiénes somos?, Qué hacemos?, and Contacto. The main title '¿Quiénes somos?' is displayed prominently in large white text against a dark green background. Below the title, a sub-section title reads 'SmartWaste: Revolucionando el Reciclaje con Inteligencia Artificial'. A detailed description follows, explaining how the company uses advanced AI technology to analyze objects for recycling. The text highlights that the AI not only identifies materials but also determines if they are in suitable conditions for processing and recycling. The page continues with another paragraph emphasizing innovation and sustainability, positioning SmartWaste as a key ally in the fight against pollution and resource depletion. At the bottom of the page is a large, circular graphic featuring a stylized profile of a human head enclosed within a hexagonal mesh, set against a background of a star-filled space.

After that, we have the ‘*What we do?*’ section, which has kind of has a big format change. The top part it’s still the same, but, the middle section is really changed. We added a black background and a good layout for a 4-point explanation.

These are the screenshots for the ‘*What we do?*’ part:

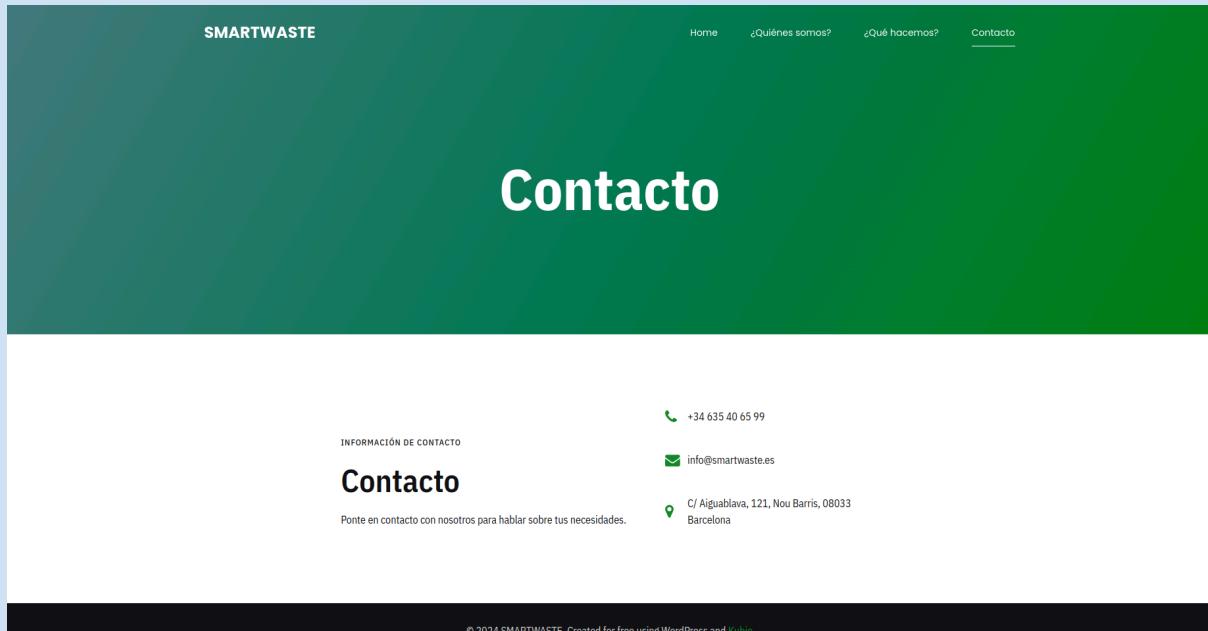
The image consists of two vertically stacked screenshots of a website for "SMARTWASTE".

**Top Screenshot:** The background is a gradient from dark green at the top to black at the bottom. At the top, there's a navigation bar with "SMARTWASTE" on the left and links for "Home", "¿Quiénes somos?", "¿Qué hacemos?", and "Contacto". The main title "¿Qué hacemos?" is centered in a large, bold, white font. Below the title, there's a sub-section title "¿QUÉ HACEMOS?" in a smaller white font, followed by the heading "Reciclaje Inteligente" in a large white font. A brief description follows, along with a "Nuestros servicios incluyen:" section. The background features a faint, stylized city skyline.

**Bottom Screenshot:** The background is black. It features the same navigation bar at the top. The main title "¿Qué hacemos?" is at the top, followed by the heading "Reciclaje Inteligente" in a large white font. Below the title, there's a description and a "Nuestros servicios incluyen:" section. This section includes four items: "Filtrado Inteligente" (with a sub-description), "Gestión Eficiente" (with a sub-description), "Análisis de Datos" (with a sub-description), and "Asesoramiento Personalizado" (with a sub-description). At the bottom of this section, there's a paragraph about the company's mission and a call to action. The background features a more detailed, dark-toned city skyline.

Finally, the contact, there's nothing much to talk about. Just added a good layout for a contact section and added some icons and our contacts.

These are the contact screenshots:



Possibly useful content:

**IMPORTANT:**

**Install LAMP modules (Linux+Apache+Mysql+PHP). Configuration of the site + necessary Apache modules.**

**Creation of an advertising website for the project created from scratch or after installing a CMS.**

**Plugin installation (shopping cart, room reservation...).**

Index:

Project development  
Research and Planning  
Software Development  
Hardware Development and Prototyping  
Testing and Optimization  
Documentation and Completion  
Team Roles and Contributions  
Results and Achievements  
Conclusions  
recommendations  
Bibliographic references  
Annexes (if necessary, e.g. additional technical details, images of the project in action, etc.)  
Executive Summary:

**Project development:**

Details about the project development process, from research and planning to testing and optimization.

**Team Roles and Contributions:**

A description of the roles of each team member and their contributions to the project.

**Results and Achievements:**

An overview of the results achieved during the development of the project and any notable achievements.

**Conclusions:**

Final conclusions based on the results of the project and its potential impact on the field of waste management.

**Recommendations:**

Possible recommendations for future projects or improvements in the SmartWaste project.

**Bibliographic references:**

A list of all sources used in the research and development of the project.

**Attachments:**

Any additional information that may be useful but not essential to the main body of the document, such as additional technical data, images or diagrams.

**Download and install the Etcher software:**

Download and install Etcher from its official website:<https://www.balena.io/etcher/>

Download the Raspbian image:

Go to the official Raspberry Pi site:<https://www.raspberrypi.org/software/operating-systems/>

Download the Raspbian image (usually in .img or .zip format).

Insert microSD card:

Connect your microSD card to the USB card reader and then connect the reader to your computer.

Open Etcher and select the image and card:

Open Etcher on your computer.

Click "Select image" and choose the Raspbian image you downloaded.

Verify that Etcher has correctly detected your microSD card.

Burn image to card:

Click "Flash" to start burning the Raspbian image to your microSD card.

Once the process is complete, Etcher will notify you that the recording has completed successfully.

Safely eject the microSD card:

Once recording is complete, safely eject the microSD card from your computer.

Update the first line, replacing bullseye with bookworm and adding non-free-firmware to the end of the line. Your sources.list file should end up looking something like this:

COPY

```
deb http://raspbian.raspberrypi.org/raspbian/ bookworm main contrib non-free rpi non-free-firmware  
Type ctrl-x to exit nano, making sure you save the file on exit. Next, you need to open raspi.list (to update the Debian Bookworm base) with this command:
```

COPY

```
sudo nano /etc/apt/sources.list.d/raspi.list
```

In this file, you only need to change bullseye to bookworm. Again, hit ctrl-x, save your changes, and exit.

Perform another full upgrade, but this time sourcing from the Bookworm repositories!

COPY

```
sudo apt update  
sudo apt full-upgrade  
sudo reboot
```

<https://www.youtube.com/watch?v=QzVYnG-WaM4>

---

```
wget https://archive.raspbian.org/raspbian.public.key -O - | sudo apt-key add -
```

