DALL-E 2 Voice-Controlled Artificial Intelligence Art Frame DIY Instructions

Say something like “Art Frame, paint a still life of fruit,” and in a matter of seconds an AI generated image depicting your request will ‘magically’ appear.

The DALL-E 2 Voice-Controlled AI Art Frame includes a 3D printed frame that houses a 7-color e-ink display and a Raspberry Pi 4. The RPi runs a python program that uses Picovoice Porcupine to detect a wake word; Picovoice Cobra voice activity detection to determine when the user begins and finishes speaking their image request; Picovoice Leopard to convert the spoken request into text; and OpenAI’s DALL-E 2 to convert the request to an image that is then displayed on a Pimoroni Inky Impression e-ink display.

The instructions below are for running the DALL-E 2 Voice-Controlled AI Art Frame on a Raspberry Pi 4, but it can also be run on other systems with minimal modifications. The process for obtaining access keys for DALL-E 2 and Picovoice solutions is the same regardless of the system used.

A brief video demo of the DALL-E 2 Voice-Controlled AI Art Frame is here: https://youtu.be/CKS973gClLE.

How to Run DALL-E 2 on a Raspberry Pi 4 Mini-Computer

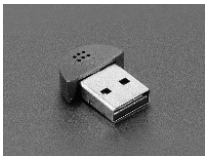
The following steps are required to run the DALL-E2 AI image generator on your Raspberry Pi 4:

- Obtain the necessary hardware
- Create an OpenAI account and obtain your personal secret API key
- Create a Picovoice account and obtain your personal secret access key
- Follow the other steps below for preparing your Raspberry Pi and downloading the DALL-E 2 Voice-Controlled AI Art Frame

Hardware Requirements

Raspberry Pi 4 – This needs to be a Raspberry Pi 4, so that you can run the 64-bit operating system. Earlier versions of Raspberry Pis are likely to throw memory errors while running this program. The 2 GB RAM model is sufficient: https://www.adafruit.com/product/4292

5v Power Supply – I recommend the official Raspberry Pi power supply: https://www.adafruit.com/product/4298



USB Microphone – for talking to the art frame. Any USB mic should work, and this inexpensive one is sufficient: https://www.adafruit.com/product/3367

Inky Impression 5.7" 7-color e-ink display – You can get one here: https://shop.pimoroni.com/en-us/products/inky-impression-5-7

LED Filament (300mm) – The program lights the LED filament when it detects the wake word and pulses it when the frame is responding to your request. This blue colored LED filament was used in the video demo: https://www.adafruit.com/product/5508

Resistor (220 ohm) – I used these: https://www.adafruit.com/product/2780

Heatsinks (recommended) – I used these: https://www.amazon.com/dp/B07ZLZRDXZ?psc=1&smid=A2PL6UUXJC5K5G&ref_=chk_typ_imgToDp

STLs for 3D-printing the DALL-E 2 Voice-Controlled AI Art Frame shown in the video demo are also available on this GitHub repository. See Appendix 1 for assembly instructions.

Create an OpenAI Account

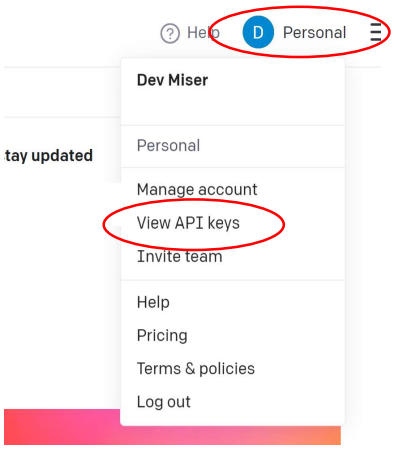
Open a web browser on your PC and navigate to the OpenAI website - https://openai.com/.

In the upper right-hand corner, click on "API"

On the next screen, click on SIGN UP and then follow the prompts to create your account.

Obtain Your Secret OpenAI API Key

Next, on the logged-in screen, click on your Personal icon in the upper right-hand corner and then click on “View API keys”.



Then click on + Create new secret key to create your new secret API key. Copy your API key and keep it in a secure location. You will need it in a later step.

Create a Picovoice Account

Create a free Picovoice account. Open a web browser and navigate to https://picovoice.ai/.

In the upper right-hand corner, click the Start Free button and follow the prompts to open your account.

Obtain Your Secret Picovoice Access Key

As soon as you complete your sign up, you will automatically be redirected to a page with your secret access key. Copy your AccessKey and keep it in a secure location. You will need it in a later step.

Prepare Your Raspberry Pi 4 to Run the Program

These instructions assume you already have a Raspberry Pi 4 set up and running. If not, set up your Raspberry Pi using the instructions found here: https://www.raspberrypi.com/tutorials/how-to-set-up-raspberry-pi/

Be certain to load the 64-bit (not the 32-bit) version of the Raspberry Pi OS when setting up your Raspberry Pi. If you use the 32-bit version, you are likely to get memory errors when running the program.

To prepare your Raspberry Pi to run the DALL-E 2 Voice-Controlled AI Art Frame, do the following:

1. Edit the bashrc file on your Raspberry Pi as follows:

a. Open a terminal  and enter the following command to open the bashrc file:

```
sudo nano ~/.bashrc
```

b. Scroll to the bottom of the file using your keyboard and add the following lines at the end (be certain to include the #s):

```
# sets a location where the Raspberry Pi OS and Python can look for
# executable/configuration files
export PATH="$HOME/.local/bin:$PATH"
```

c. Press the CTRL and X keys simultaneously on your keyboard, then press Y and then press Enter to save the revisions to the file.

d. Then enter the following command:

```
sudo reboot
```

This will reboot your Raspberry Pi. After the reboot is completed, log back in.

2. Open a terminal and enter the following commands in the following order:

```
sudo apt update
```

```
sudo apt full-upgrade - If asked if you want to continue, enter Y and then press Enter
```

```
pip3 install --upgrade pip
```

```
sudo apt-get install portaudio19-dev - When asked if you want to continue, enter Y and then press Enter
```

```
pip3 install pyaudio
```

```
pip3 install pvrecorder
```

```
pip3 install pvporcupine
```

```
pip3 install pvcobra
```

```
pip3 install pvleopard
```

pip3 install schedule

pip3 install inky[rpi,example-depends]

pip3 install --upgrade openai

sudo reboot – will reboot your Raspberry Pi; log back in after the reboot.

3. Enable the SPI and I2C interfaces as follows:

a. Open a terminal and enter the following command:

sudo raspi-config

b. Using the arrows on your keyboard, scroll down to “3 Interface Options” and press Enter

c. Scroll down to “I4 SPI” and press Enter

d. The next screen will ask “Would you like the SPI interface to be enabled?” Select “Yes” and press Enter.

e. The next screen will state “The SPI interface in enabled”. Select “Ok” and press Enter.

f. Scroll down to “3 Interface Options” and press Enter

g. Scroll down to “I5 I2C” and press Enter

h. The next screen will ask “Would you like the ARM I2C interface to be enabled?” Select “Yes” and press Enter.

i. The next screen will state “The ARM I2C interface is enabled”. Select “Ok” and press Enter.

j. Scroll down to select “Finish” and press Enter

4. Download the AIArtFrame.py program and associated files by opening a terminal and entering the following command:

git clone https://github.com/DevMiser/AI_Art_Frame.git

5. Modify AIArtFrame.py to include the secret API key that you previously created in your OpenAI account and the secret access key that you created in your Picovoice account by doing the following:

a. Open a terminal and enter the following commands:

cd /home/pi/AI_Art_Frame

sudo nano AIArtFrame.py

b. Use your keyboard to scroll down to the lines that say:

openai.api_key = "*put your secret API key between these quotation marks*"
pv_access_key= "*put your secret access key between these quotation marks*"

Now modify those lines to replace the portions that are italicized above with your secret OpenAI API key and your secret Picovoice access key, respectively.

c. Press the CTRL and X keys simultaneously on your keyboard, then press Y and then press Enter to save the revisions to the file.

6. Move the Art-Frame keyword file to the Porcupine raspberry-pi folder by entering the following command:

mv /home/pi/AI_Art_Frame/Art-Frame_raspberry-pi.ppn /home/pi/.local/lib/python3.9/site-packages/pvporcupine/resources/keyword_files/raspberry-pi

Note that there are two blank spaces in the above command - between "mv" and "/home" and between ".ppn" and "/home". Be sure to include them.

7. Reboot your Raspberry Pi.

Run the Program

Plug your microphone into an USB port on your Raspberry Pi 4.

To run the program, open a terminal and enter the following commands:

cd /home/pi/AI_Art_Frame

python3 ArtFrame.py

You can then wake up your DALL-E 2 Voice-Controlled AI Art Frame by saying one of the following wake words: Art-Frame, computer or Jarvis.

When the frame detects the wake word, the LED filament will illuminate. You can then make your request. For example, try:

A portrait of Albert Einstein.

A field of flowers with mountains and a rainbow in the background.

An oil painting portrait of an old fisherman.

An album cover for a punk band.

A fashion model in the style of Roy Lichtenstein.

A schooner in a storm at sunset.

Flower pedals with morning dew.

A glass bowl full of jellybeans.

A bouquet of helium balloons tied to a park bench.

After you complete your request, the LED filament will pulse on and off until DALL-E2 processes it and your AI-generated image is displayed. Because e-ink displays work by drawing positively or negatively charged colored particles to the top of thousands of tiny oil-filled bubbles lined up against the surface of the display, this will take several seconds.

You can remove the microphone from the USB port when not in use so that it is not visible while displaying your new art in your frame.

When you are finished with the program, press the CTRL and C keys simultaneously on your keyboard and you will exit the program.

Clearing and Refreshing the E-Ink Display

In addition to requests for new images, you can instead ask the DALL-E 2 Voice-Controlled AI Art Frame to clear the current image and display a blank screen. To do this, after you awake the frame with the wake word, say “Clear the screen,” “Wipe the display”, or similar. The DALL-E 2 Voice-Controlled AI Art Frame will then cycle the screen through a series of solid colors, leaving the screen blank at the end.

The DALL-E 2 Voice-Controlled AI Art Frame is also programmed to refresh the current image each night at midnight if the power supply is plugged in. This is intended to help prevent burn-in of images on the display. When active, at midnight the DALL-E 2 Voice-Controlled AI Art Frame will cycle the screen through a series of solid colors, and then refresh to display the same image it was displaying before the refresh began.

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APPENDIX I

Assembling the DALL-E 2 Voice-Controlled AI Art Frame

The recommend settings for slicing the STLs for the screen are at a setting of 0.15mm with 20% infill. Print the screen face up with supports – organic supports with no interface layers if possible. Block the generation of supports for the holes in the frame for the filament and the screw holes in the four guides on the frame for the stabilizers.

In addition to the STL, pre-sliced G-Code (in a zip file) for printing the frame with organic supports is also available on this GitHub repository.

The Display Stabilizers can be 3D printed without supports.

You need two of each stabilizer – Display Stabilizer w Tabs and Display Stabilizer Plain.

In addition to the STLs, pre-sliced G-Code for printing all four stabilizers at once is also available on this GitHub repository.

The tabs can either be glued in place or attached with screws – self-tapping 2.5 mm or #4 US diameter and no more than 10mm long. See Figure 1.

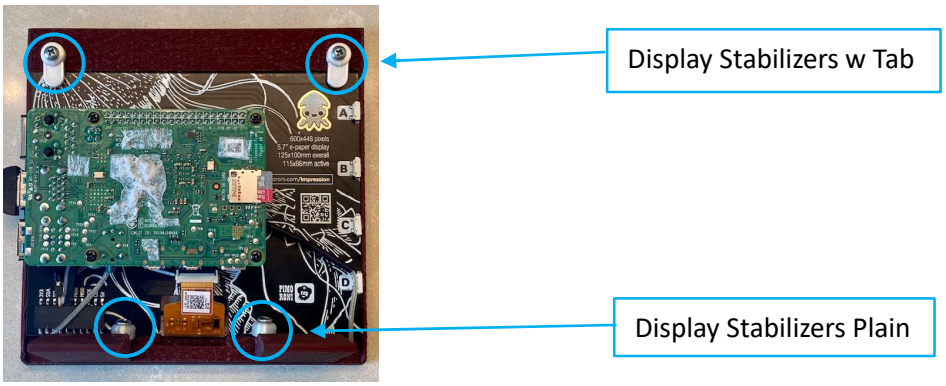


Figure 1

The LED filament is threaded through the two holes in the printed frame and pressed gently to seat it in the channel at the bottom of the frame. You may need to gently pull the end of the filament with needlepoint pliers to thread it though the holes.

The LED filament is soldered to one end of the LED filament and the resistor. The resistor and the other end of the LED filament are then inserted into the GPIO extender on the back of the Inky Impression to GND and 4, respectively, as shown in Figure 2 below.

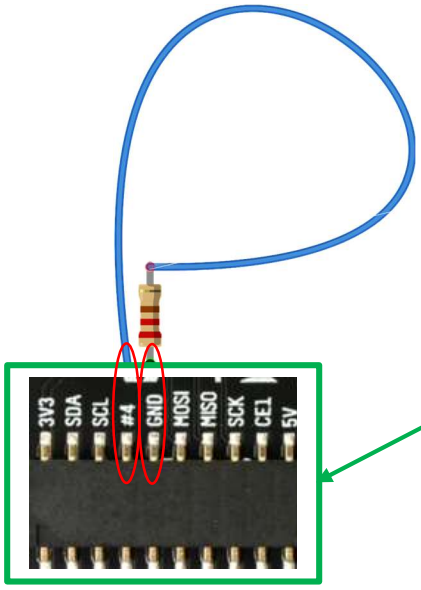
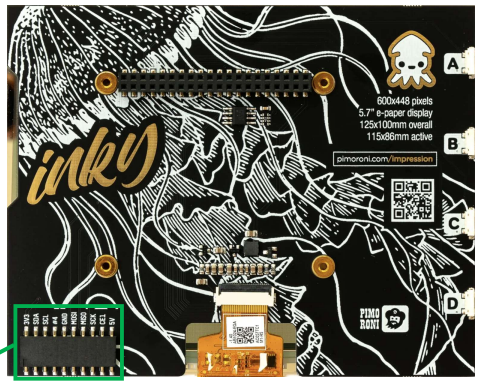


Figure 2



Back of the Inky Impression Display

The LED filament will light up when the program hears the wake word and will pulse after the user finishes their query and while the assistant provides its response. The proper wiring of the LED filament and resistor is to the no. 4 GPIO connector and to the GND GPIO connector.

If the cord to the Power Supply interferes with how the frame sits, you can use a USB C Male to USB C Female Angle Connector.