
life.augmented

# STM32H7R-S workshop
# Graphical UI

# Advanced Graphics UI

- Advanced graphics UI demand:
  - **Substantial ROM** for housing an extensive collection of graphical assets (bitmaps, fonts)
  - **Sufficient RAM** to hold the frame buffer (size determined by the screen resolution, color depth)
  - **High-speed bus interface** to ensure high frame rates
  - **Powerful computation capabilities** for graphics rendering
- STM32H7R/S offers:
  - Choose external ROM / RAM fitting your UI requirements
  - High-speed external memory interfaces with speeds up to 200 MHz DTR
  - ARM Cortex-M7 running @600 MHz, bolstered by graphic accelerators and enablers

→ For the graphics demo on your board assets size is around 45.8 MBytes

→ Configuration :
screen resolution 800x480
16 bits color depth with double frame buffer.

Frame buffer size: 800x480 * 16 bits*2: 1500 KBytes

# High Performance Graphics on STM32H7R/S

**Graphical accelerator :**

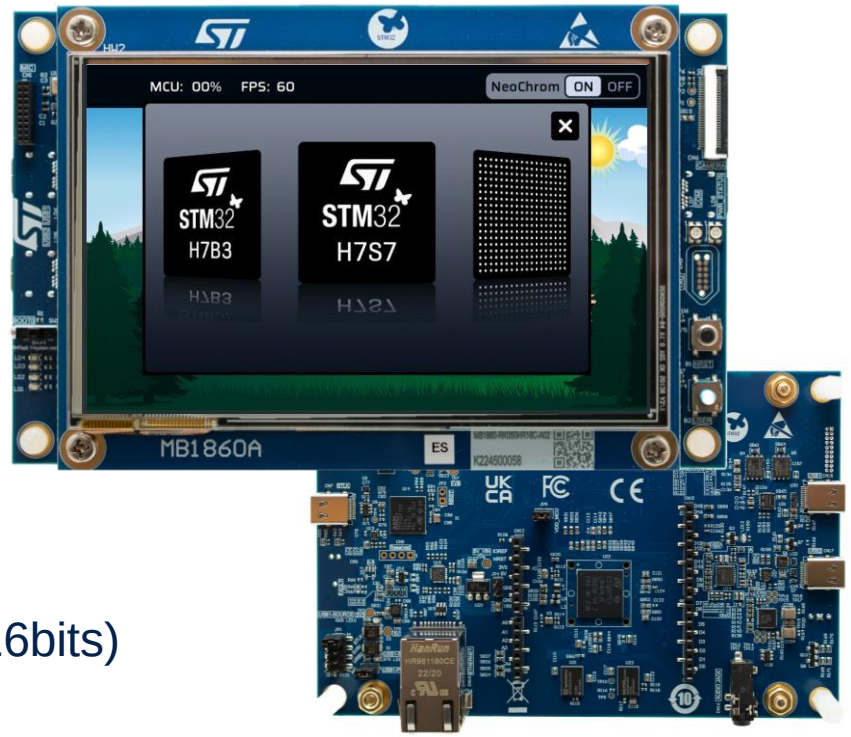
- Chrom-ART ™ (DMA2D)
- **NeoChrom GPU ™** (GPU2D)

**Graphic enablers**

- JPEG CODEC for accelerating MJPEG Videos
- Chrom-GRC ™ (GFXMMU)

**Supported display interface:**

- Parallel (FMC) interface displays supporting up to WSVGA (1024×600 16bits)
- **Parallel LCD-TFT controller** (LTDC) supporting up to SVGA resolution (800 × 600 24bits)
  Format : RGB-TFT 16/18/24bits and parallel 8080 display interface




life.augmented

# STM32 hardware embedded graphics HW acceleration

## **NeoChrom** GPU (GPU2D)

Offloads the CPU from graphics tasks
Lower memory consumption
Higher GUI performance – smooth and richer graphics effects:

- Realizing 3D-like graphics on STM32 microcontroller

➔ **The technology behind**

- Simple Drawing
- 2D Copy
- Alpha blending
- Color format conversion

- **Advanced Drawing**
- **Scaling, Rotation**
- **Perspective correct texture mapping**
- Image format compression



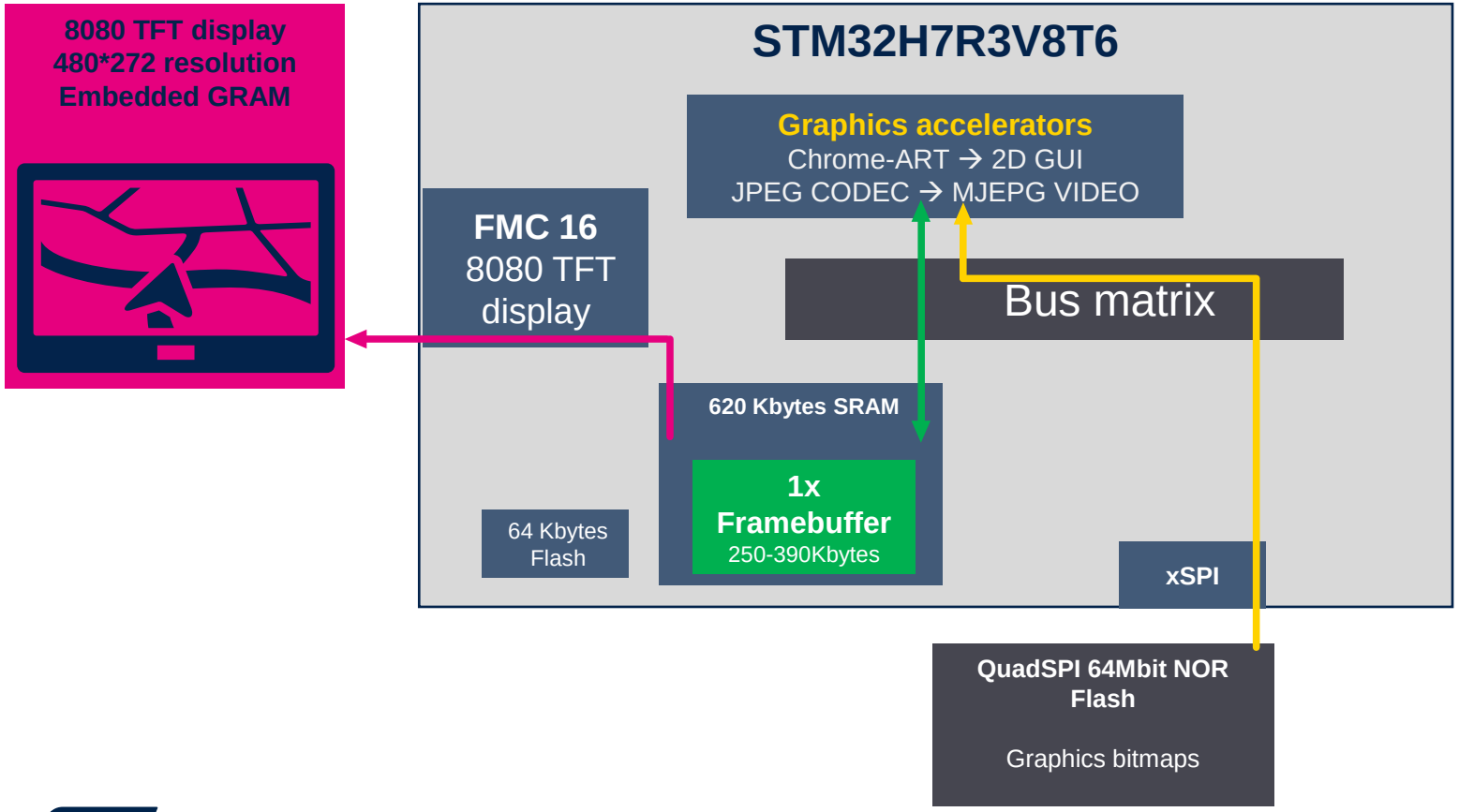
life.augmented

# STM32H7R3: **Simple Purpose GUI**

**100K BoM Estimations (MCU + memory)**

- STM32H7R3V8T6: 2.4 $
- QuadSPI 64Mbit: 0.6 $

**Total Estimations: 3 $**




**UI requirements**

1. 480*272 16 or 24bpp.
2. 2D graphics
3. Background, few buttons, text
4. Display sensor inputs
5. Control xy machine settings
6. 5 screens, simple screen transitions

**Other requirements**

- Ethernet for PoE and communication
- CAN-FC for machine/industrial communication

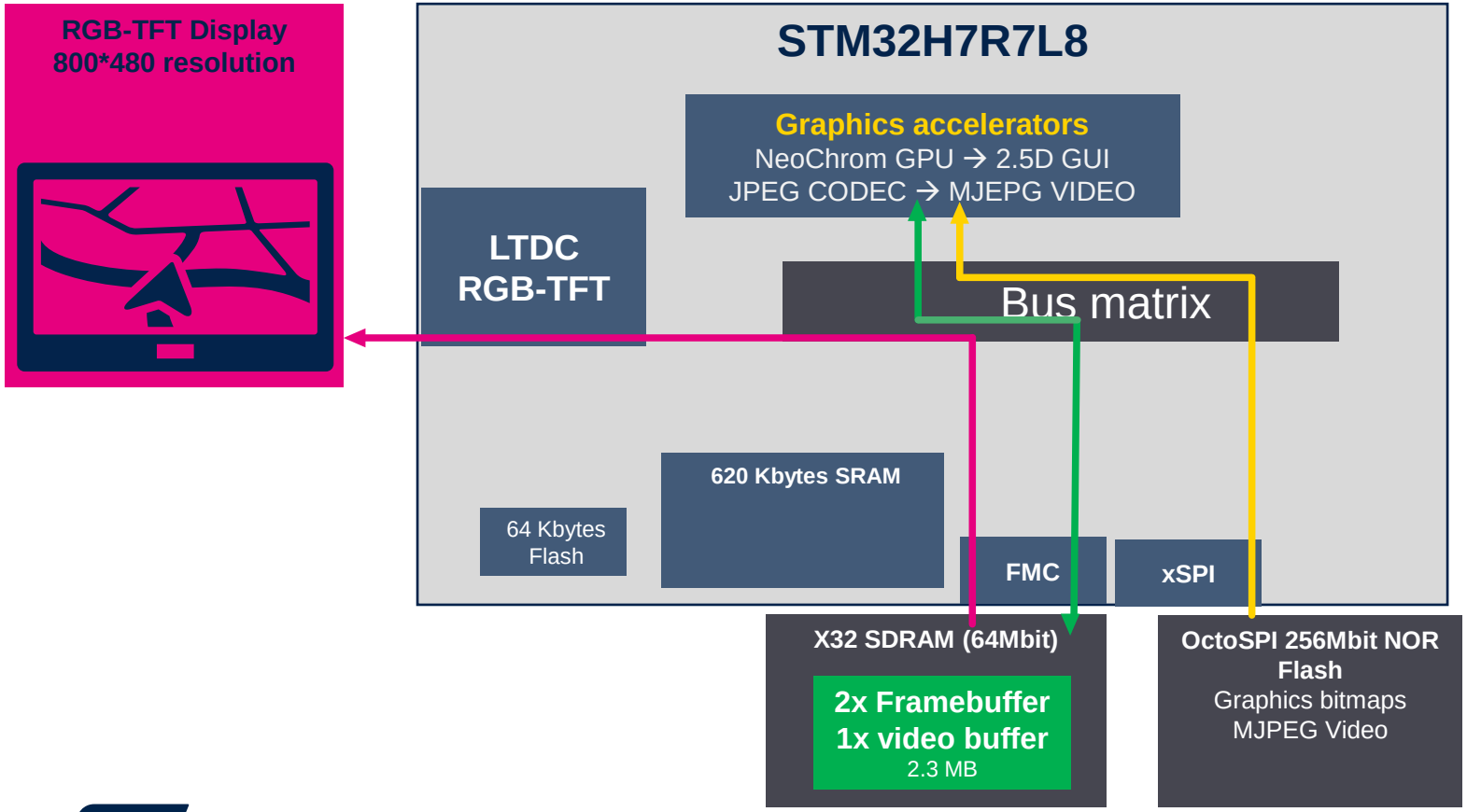
**Microcontroller & Memory**

**CPN:** STM32H7R3V8T6
**Package:** LQFP100
**External flash:** QuadSPI NOR
**External ram:** N/A

Step 1 : Chrom-ART callback to get the assets from external flash
Step 2 : The image is processed by Chrom-ART and stored into dedicated memory in internal SRAM
Step 3 : The framebuffer is transferred to the display

life.augmented

# STM32H7R7: **High performance GUI**




**100K BoM Estimations (MCU + memory)**

- STM32H7R7L8: 3.7 $
- Octal SPI 256 Mbit: 1.5 $
- 32bit SDRAM 64Mbit: 1 $

**Total Estimations: 6.2 $**

**UI requirements**

1. 800*480 16 bpp. 60FPS
2. 2 & 2.5D graphics
3. Background, buttons, sliders, etc.
4. Scaling of icons on a slider wheel
5. MJPEG video fullscreen
6. Display and control product via UI

**Other requirements**

- Memory scalability to accomdate different markets.
- OTA FW update requireing dual bank ext memory
- Ethernet*

**Microcontroller & Memory**

**CPN:** STM32H7R7L8
**Package:** TFBGA225
**External flash:** OctoSPI Flash
**External ram:** SDRAM

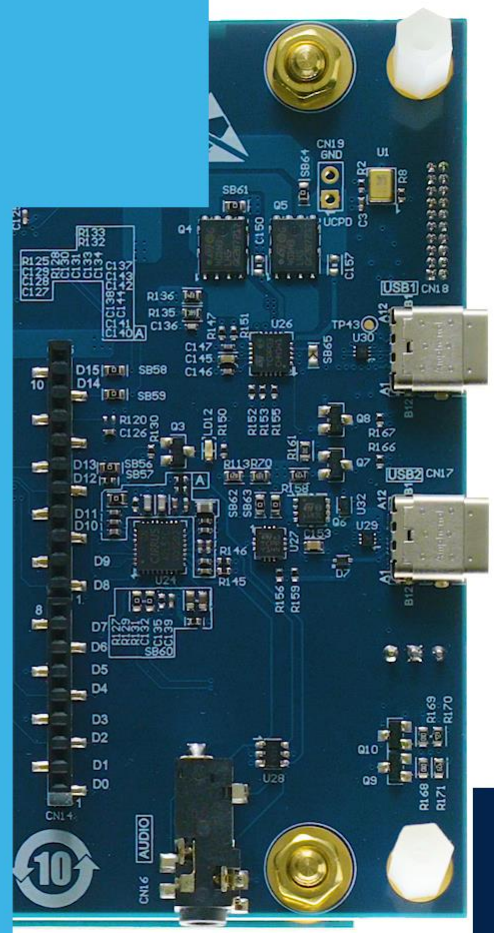
Step 1 : NeoChrom callback to get the assets from external flash
Step 2 : The image is processed by Neochrom and stored into dedicated memory in External RAM
Step 3 : The framebuffer is transferred to the display

* On LQFP package, LDTC and ETH can't be used simultaneously

life.augmented

# STM32H7S8-DK Demo

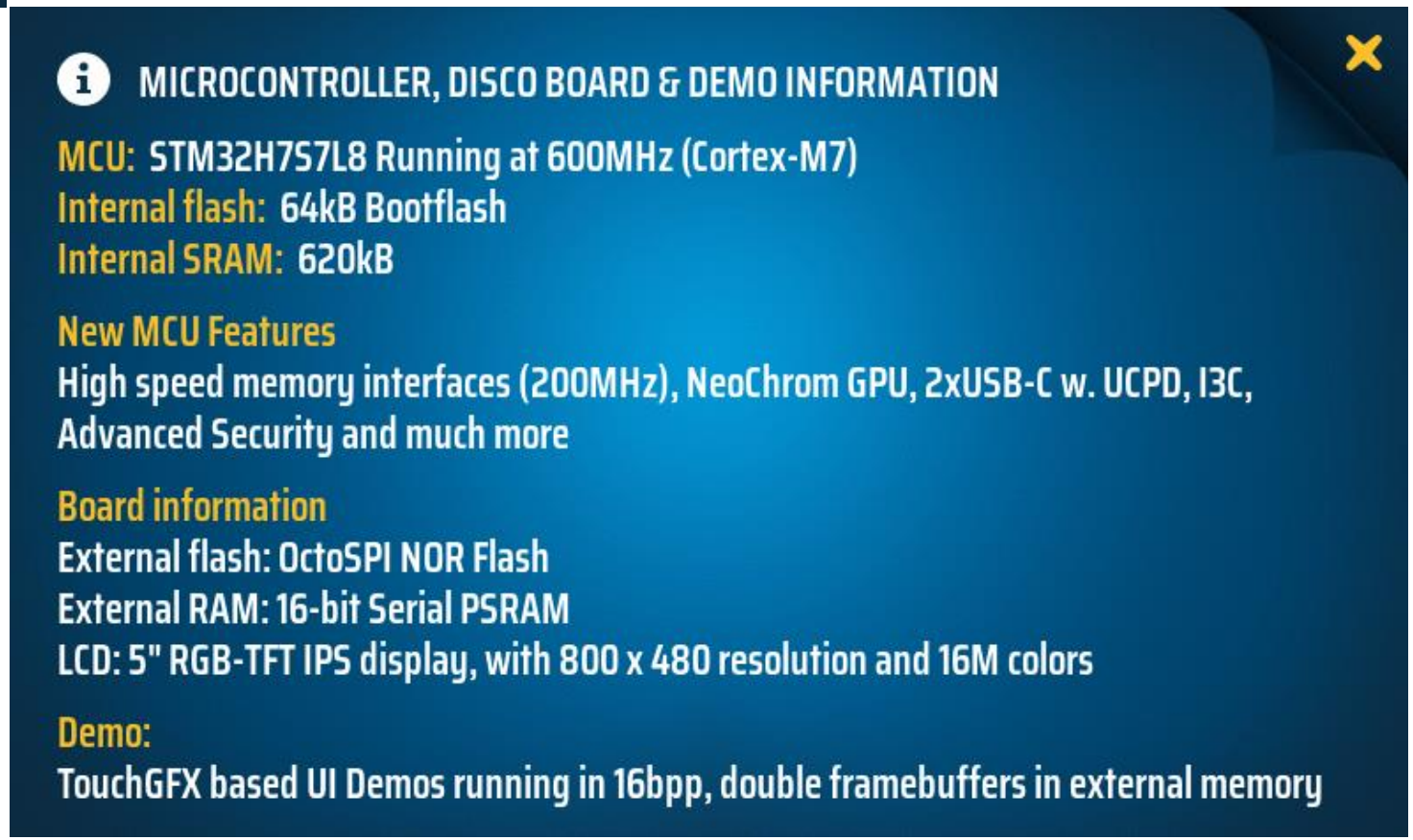
Run MPU-Like
GUI applications
on STM32H7RS




life.augmented

https://www.youtube.com/watch?v=Ho_lXv0RQqo&t=1s

# TouchGFX sub-demo overview

# TouchGFX sub-demo overview


**SVG demo**

Cortex-M7 at 600Hz enable smooth vectorial graphic


life.augmented

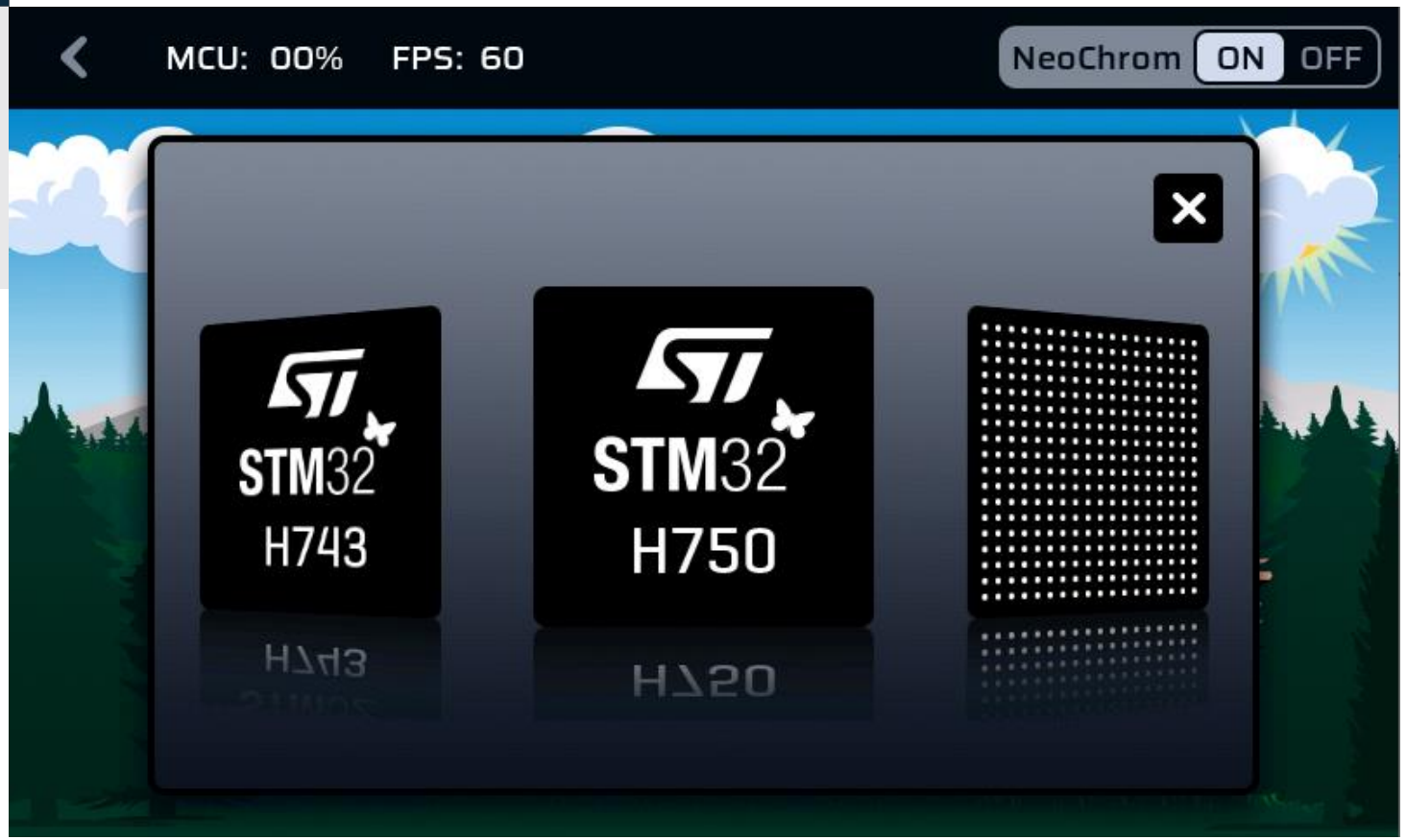

# TouchGFX sub-demo overview

NeoChrom **ON**
CPU: ~14%
FPS: 60

NeoChrom **OFF**
CPU: ~80%
FPS: 19

## Rousset Factory

Bitmap scaling
Bitmap rotations
Perspective correct texture mapping



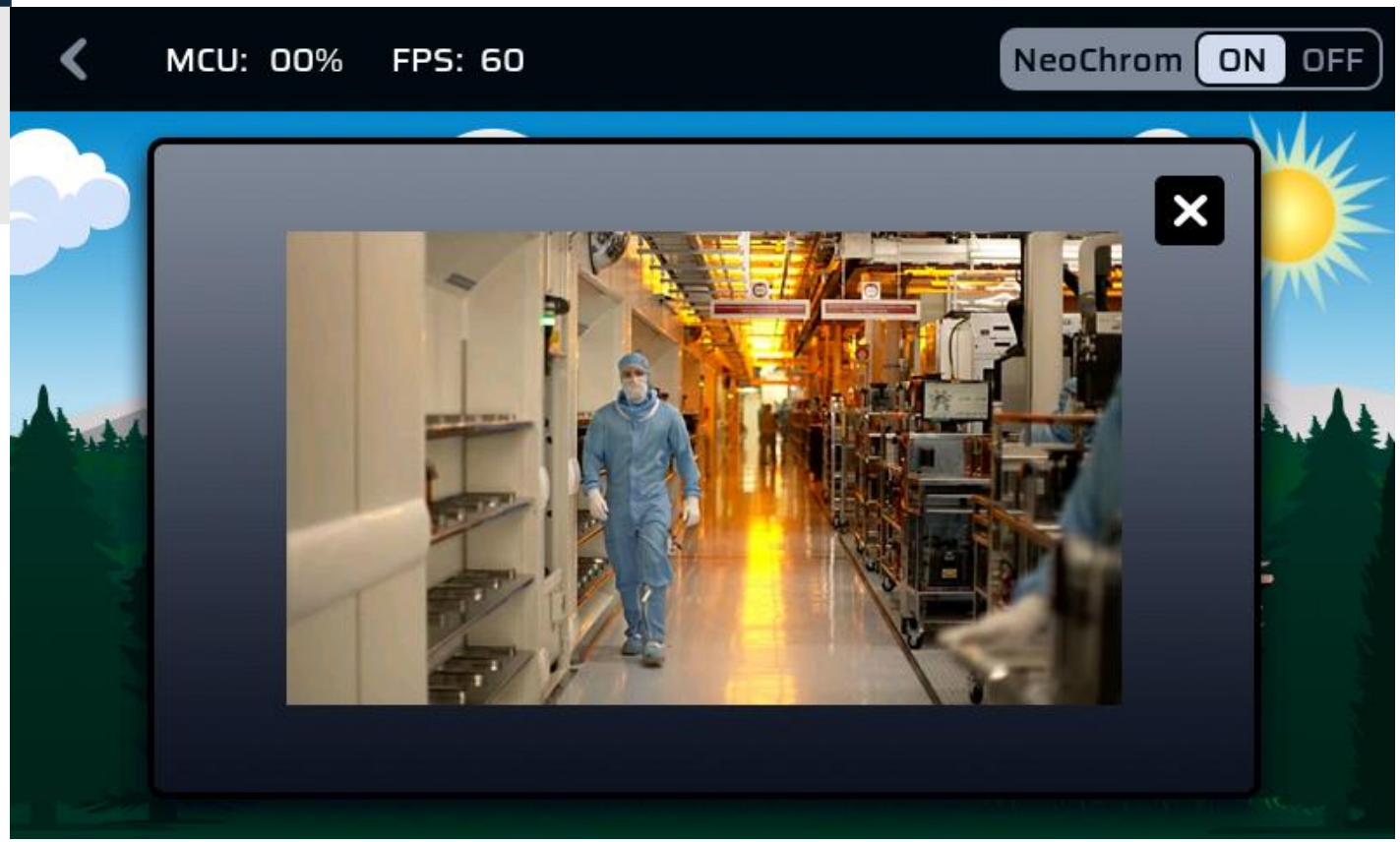

life.augmented

# TouchGFX sub-demo overview


**MJPEG video**
480*272 MJPEG video

NeoChrom **ON**
CPU: 30%
FPS: 60

NeoChrom **OFF**
CPU: ~80%
FPS: 30




life.augmented

# TouchGFX sub-demo overview

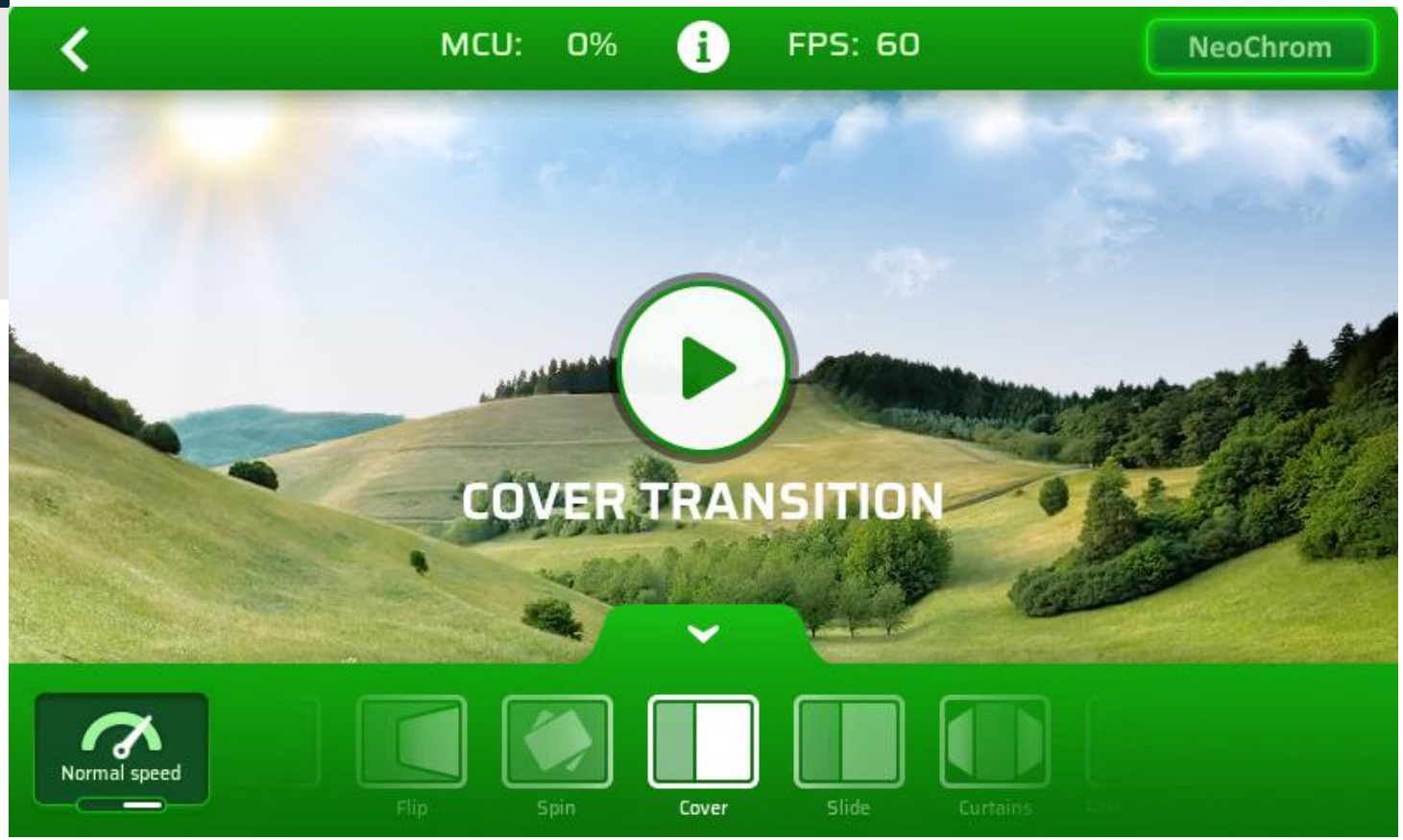

**Screen Transition**

Full screen bitmap animation (spin out)

Bitmap rotation, scaling, move, spin, etc.

Menu overlay

| NeoChrom **ON** | NeoChrom **OFF** |
|---|---|
| CPU: ~5% | CPU: ~77% |
| FPS: ~35-60 | FPS: 25 |




life.augmented

# TouchGFX sub-demo overview


**Compass**
Large bitmap rotation

| NeoChrom **ON** | NeoChrom **OFF** |
|---|---|
| CPU: ~5% | CPU: ~85% |
| FPS: ~45-60 | FPS: 20 |


life.augmented

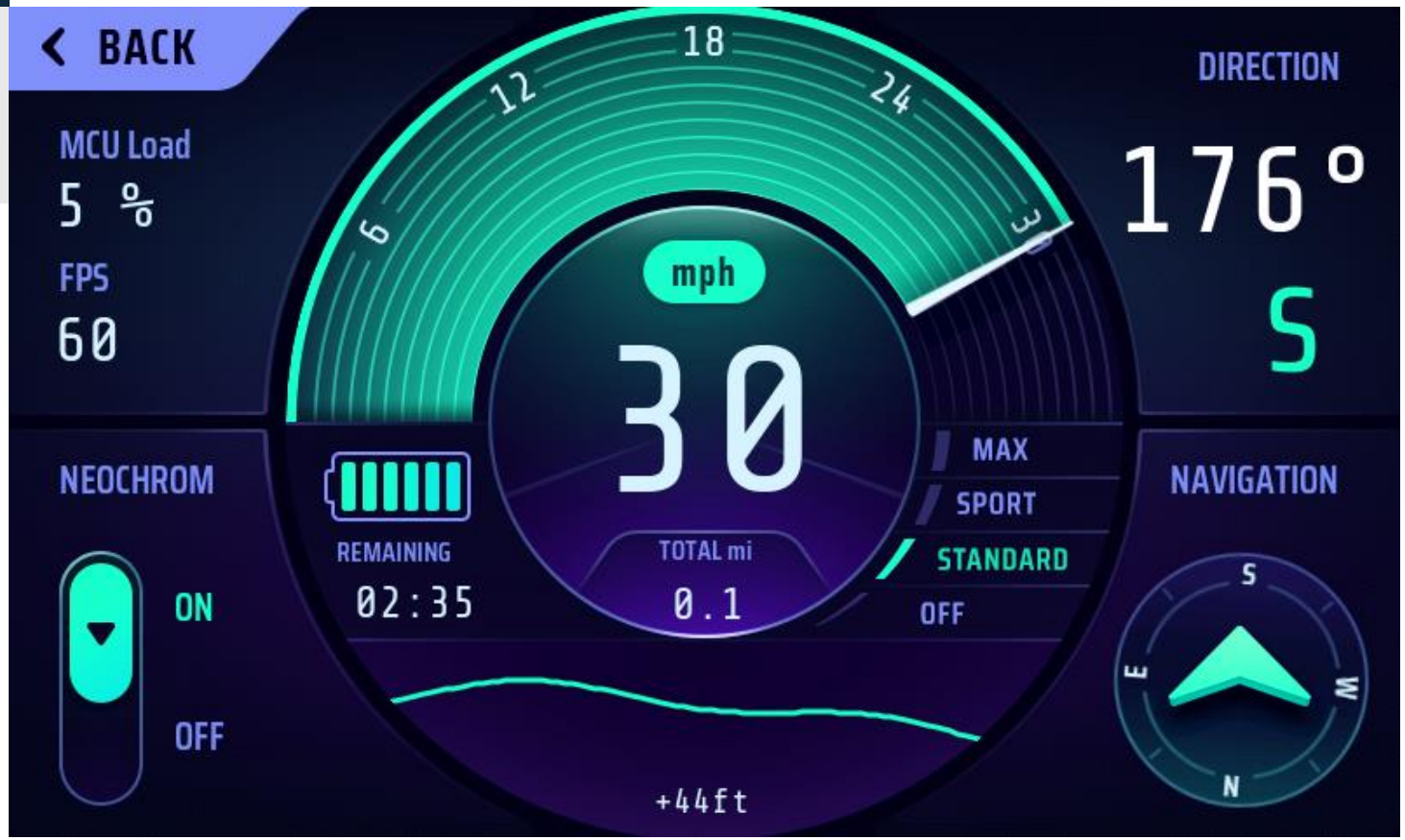

# TouchGFX sub-demo overview

NeoChrom **ON**
CPU: ~40%
FPS: 60

NeoChrom **OFF**
CPU: ~60%
FPS: 30

## E-Bike

Anti-aliased drawing (graph)
Alpha blending
Gauge with rotating needle



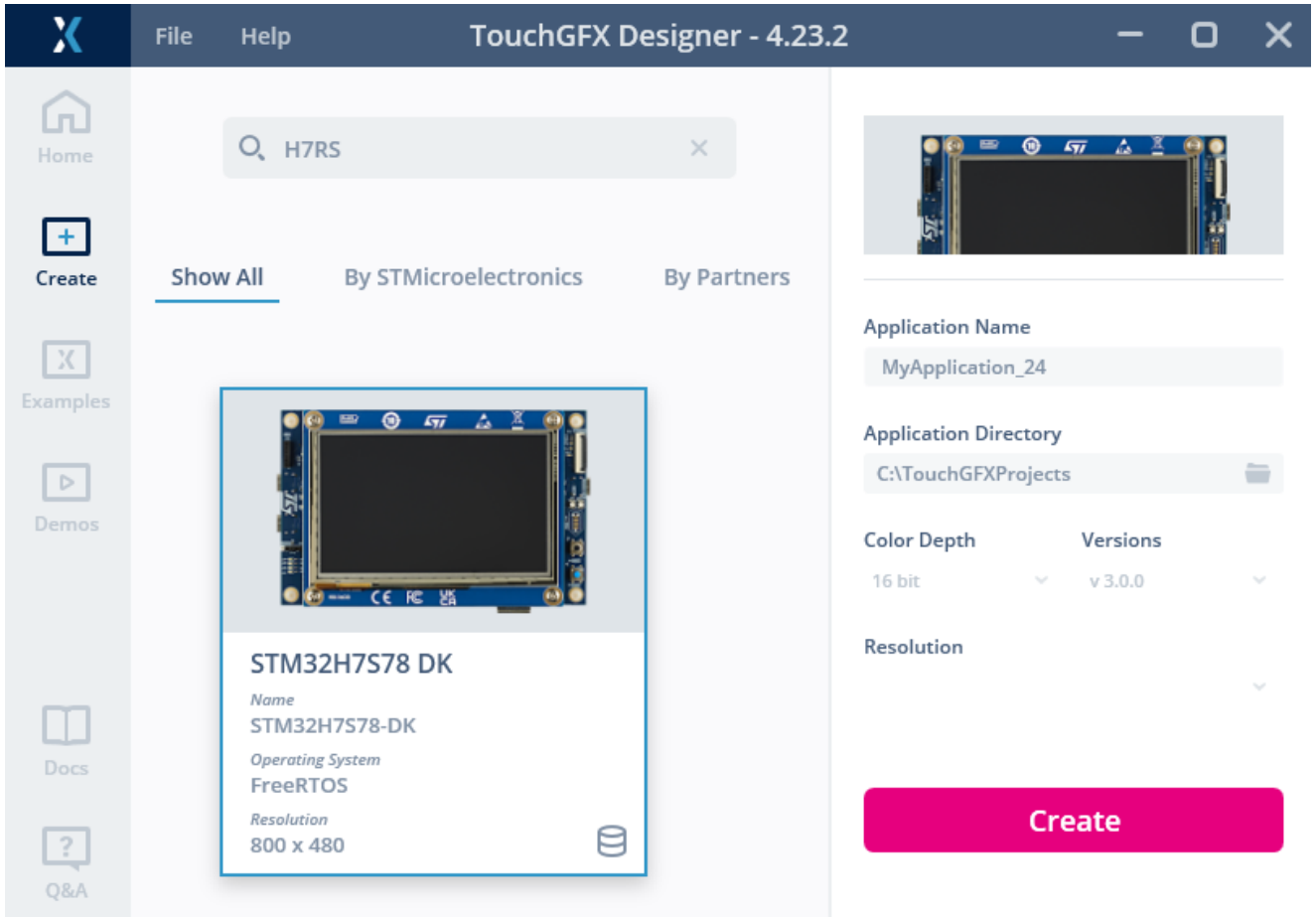
# **Free GUI Solution** for STM32H7R/S

## Utilize the X-Cube-TouchGFX Free software tool for developing amazing graphical user interfaces.

- High performance
- Low memory footprint
- WYSIWYG PC Tool with PC Simulator
- +40 widgets
- Free stock-images
- Multi language
- Raster and Vector graphics

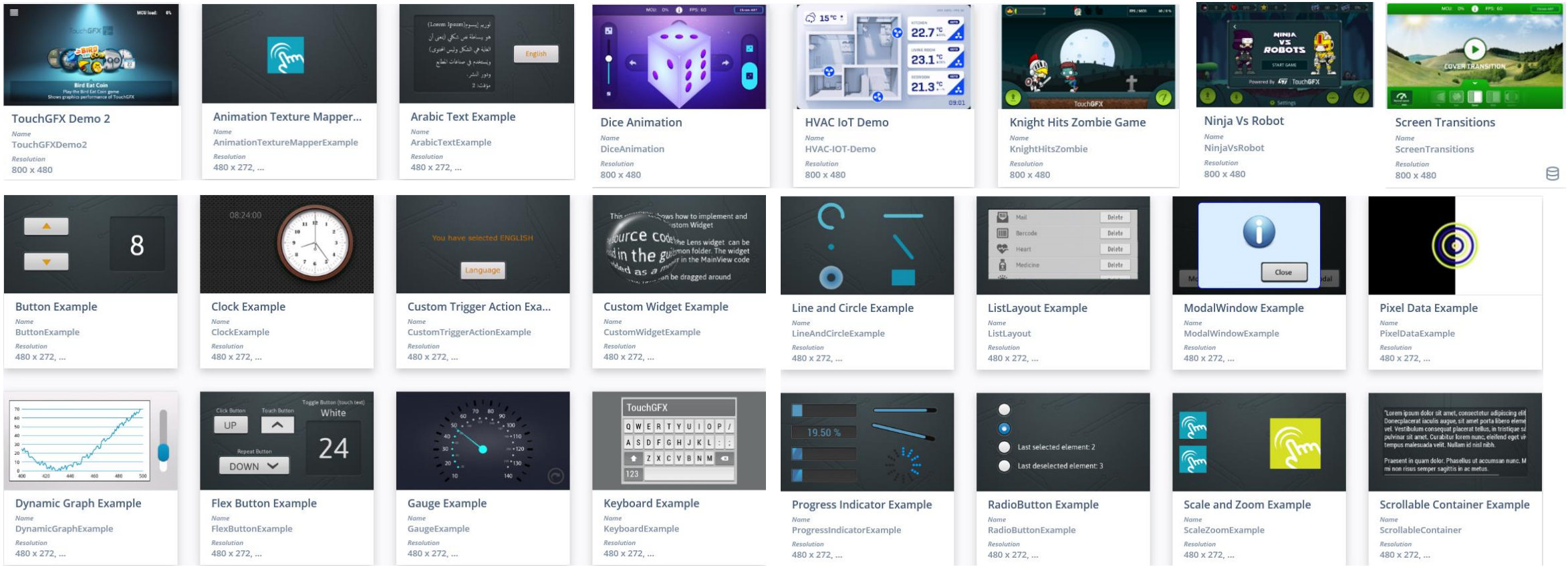

life.augmented

# TouchGFX Board Setup for STM32H7S78-DK

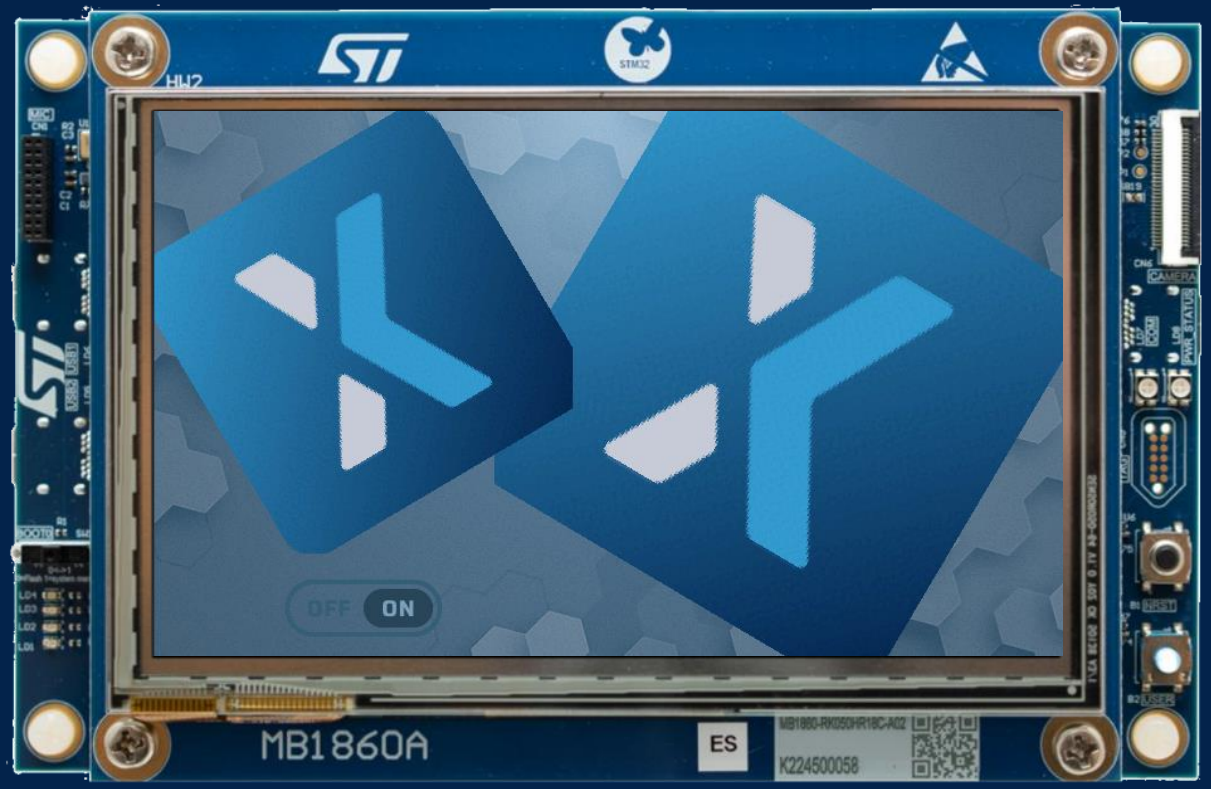

**Available now !**

# Many code example and demo supported STM32H7S78-DK




life.augmented

# STM32H7R/S TouchGFX Demo with STM32H7S78-DK




https://github.com/ST-TOMAS-Examples-Gfx/stm32h7rs_touchgfx_neochrom_benefit

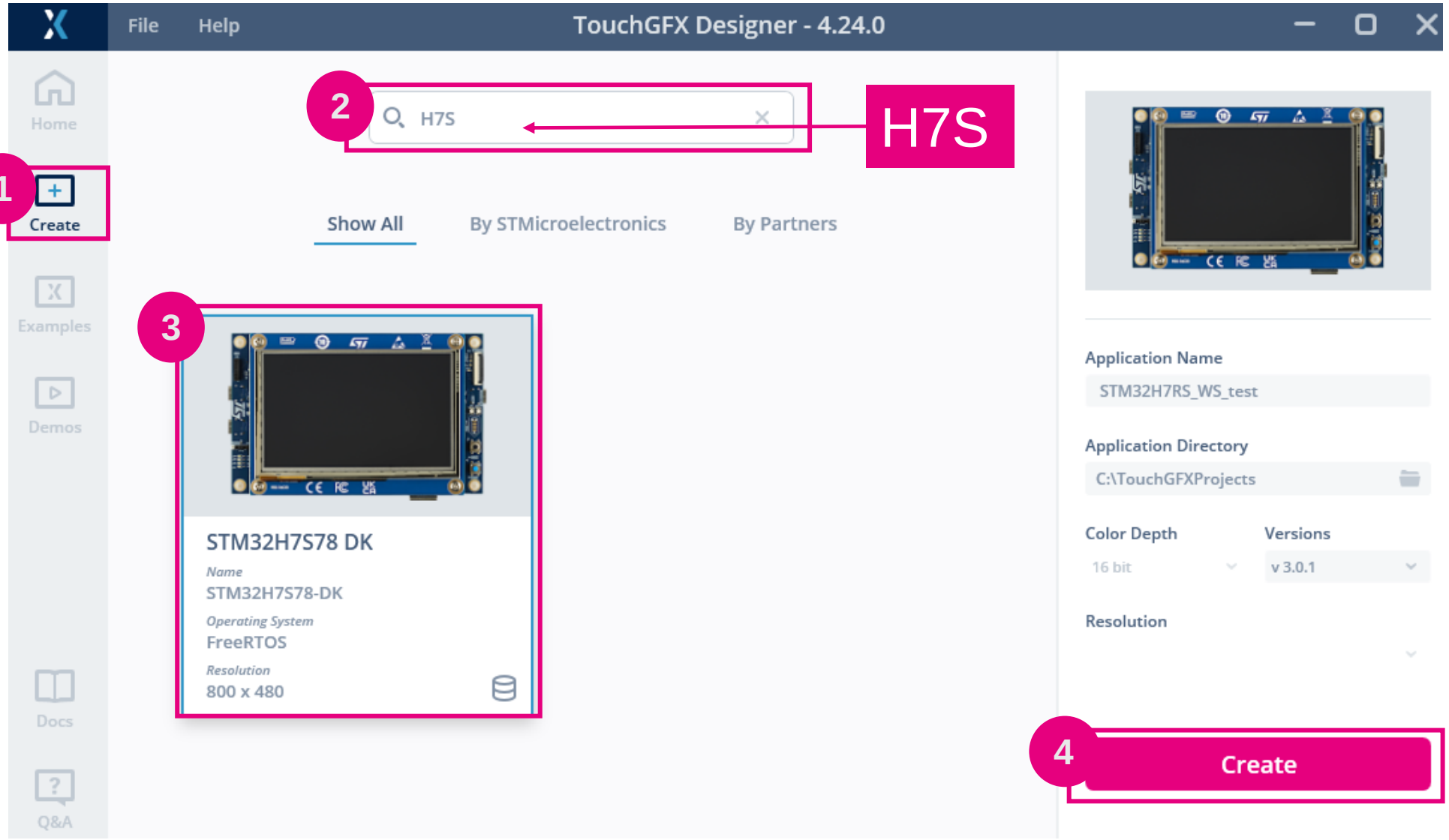
life.augmented

# Create a TouchGFX UI which demonstrate NeoChrom benefit


life.augmented

TouchGFX 4.24.0 Designer
App

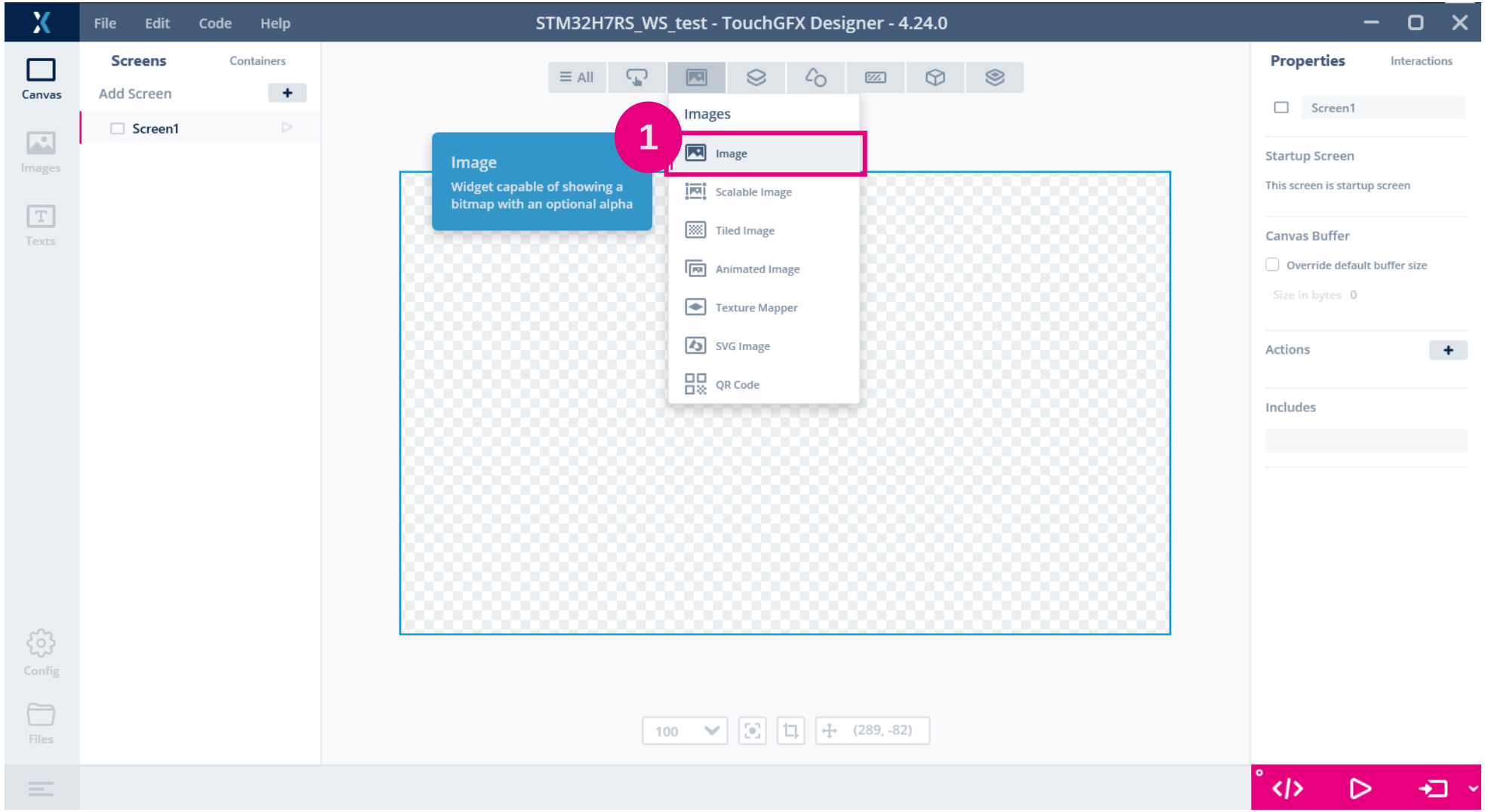
# Start a project for STM32H7S78-DK




life.augmented

TouchGFX 4.24.0 Designer
App

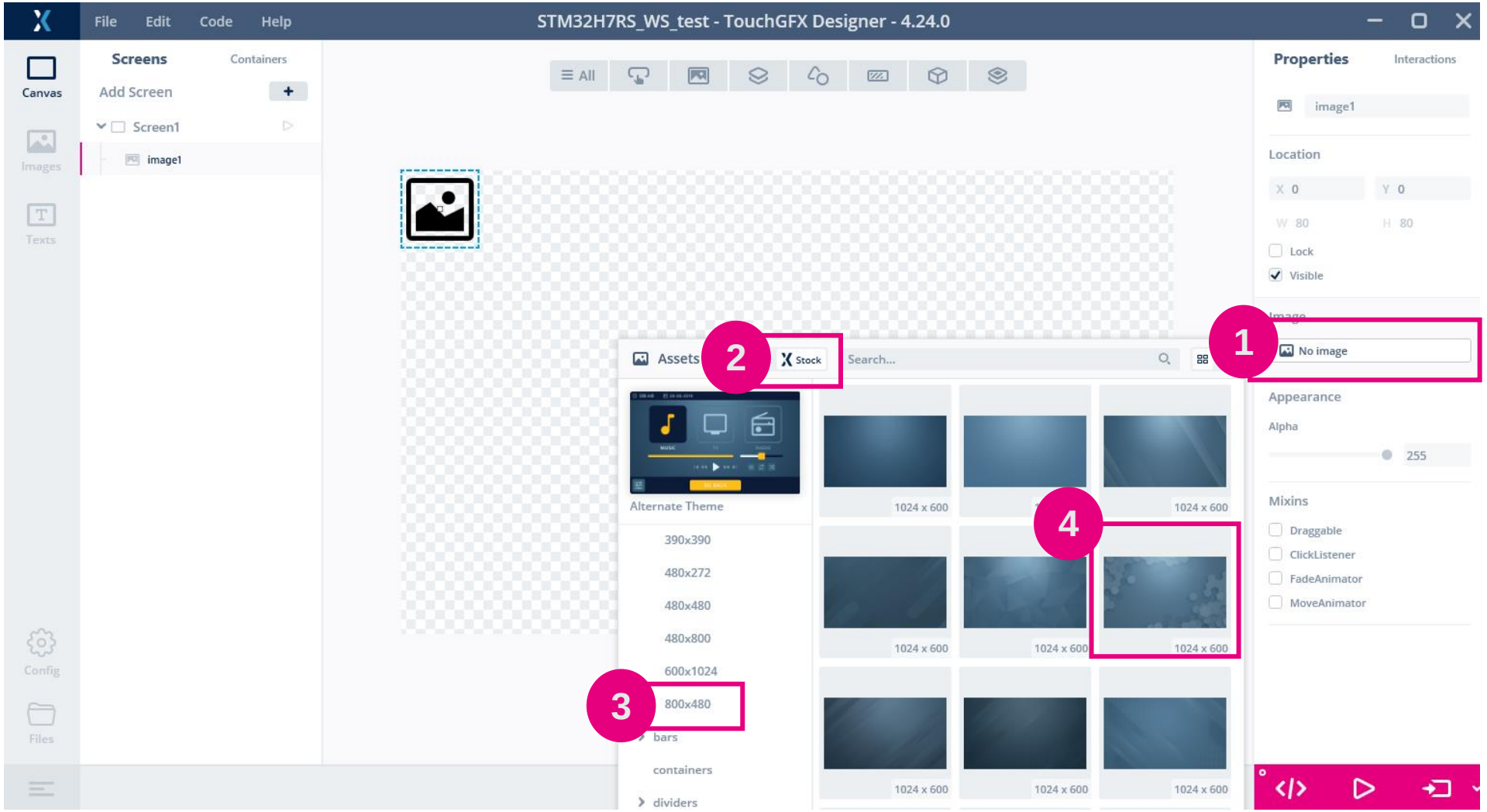
# Insert an image




life.augmented

TouchGFX 4.24.0 Designer
App

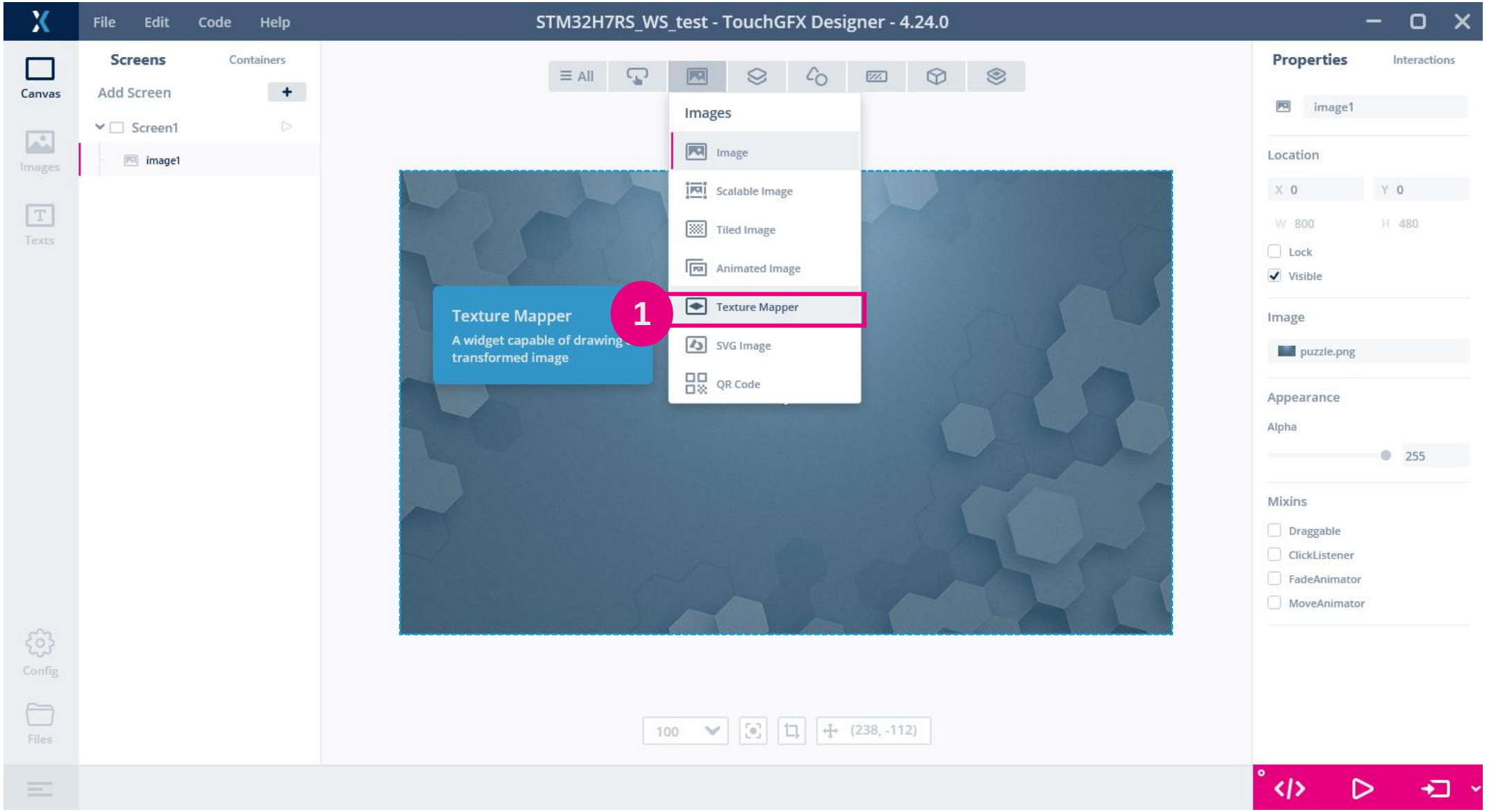
# Chose the background image




life.augmented

TouchGFX 4.24.0 Designer
App

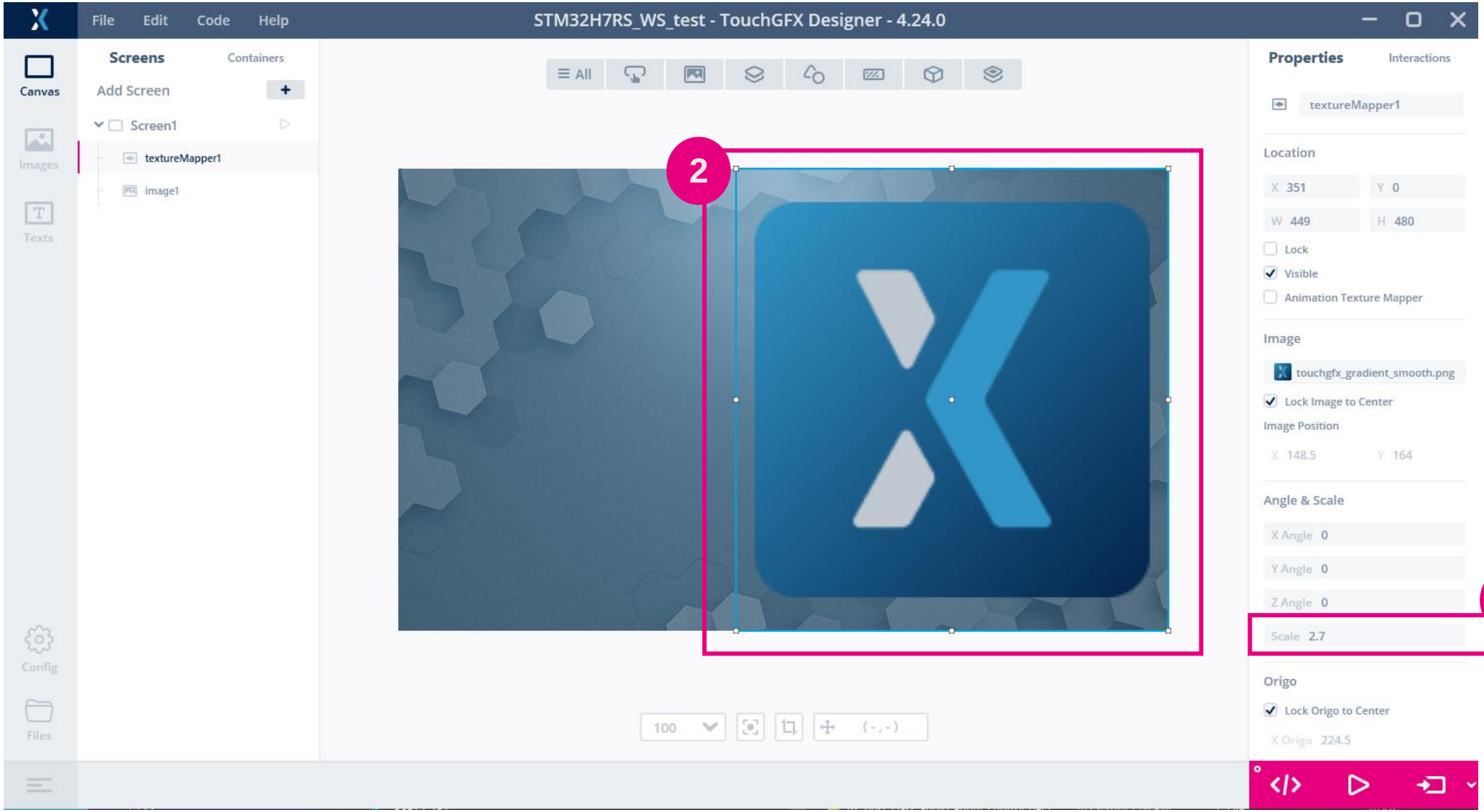
# Insert a texture mapper




life.augmented

TouchGFX 4.24.0 Designer
App

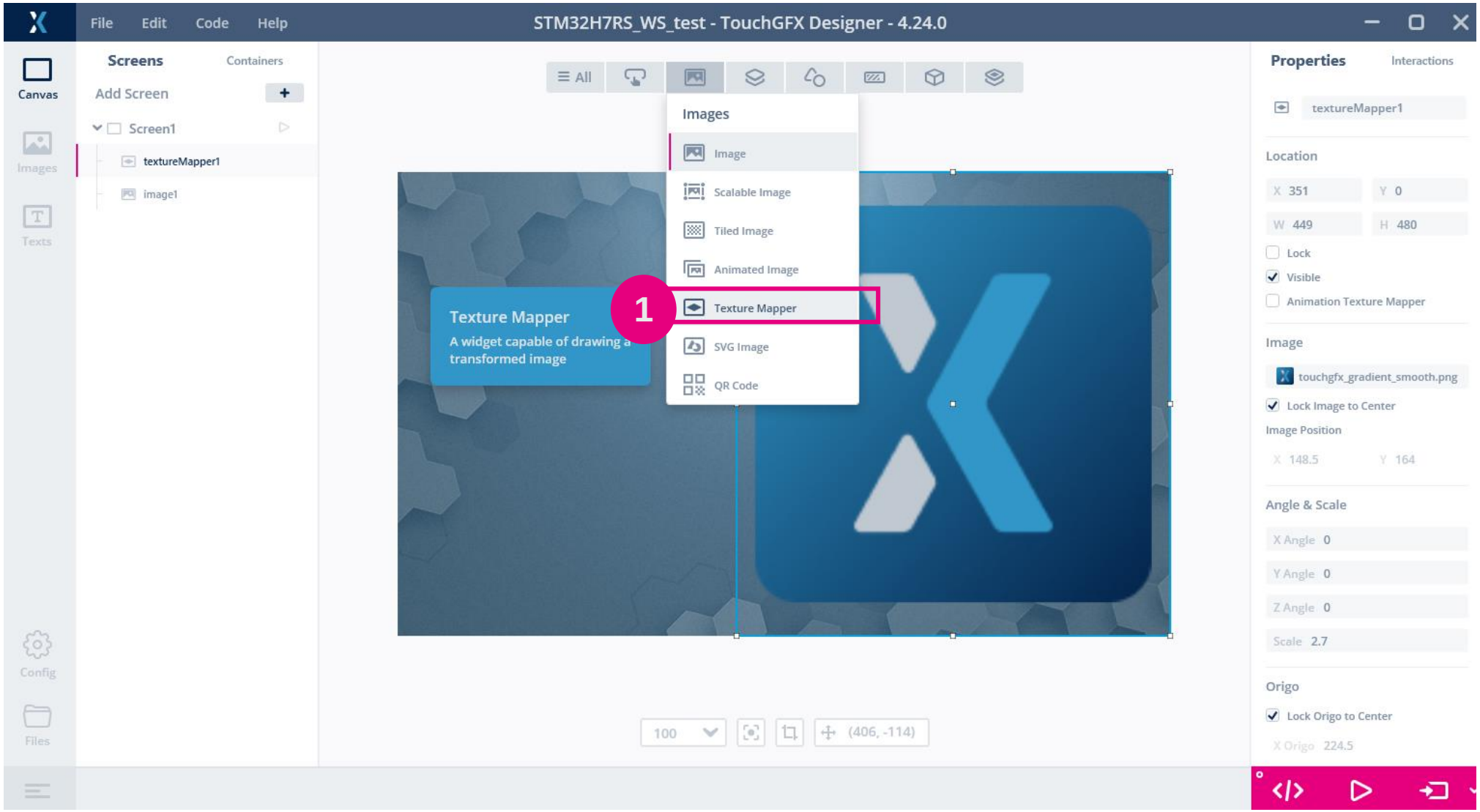
# Increase the size and update location




life.augmented

TouchGFX 4.24.0 Designer
App

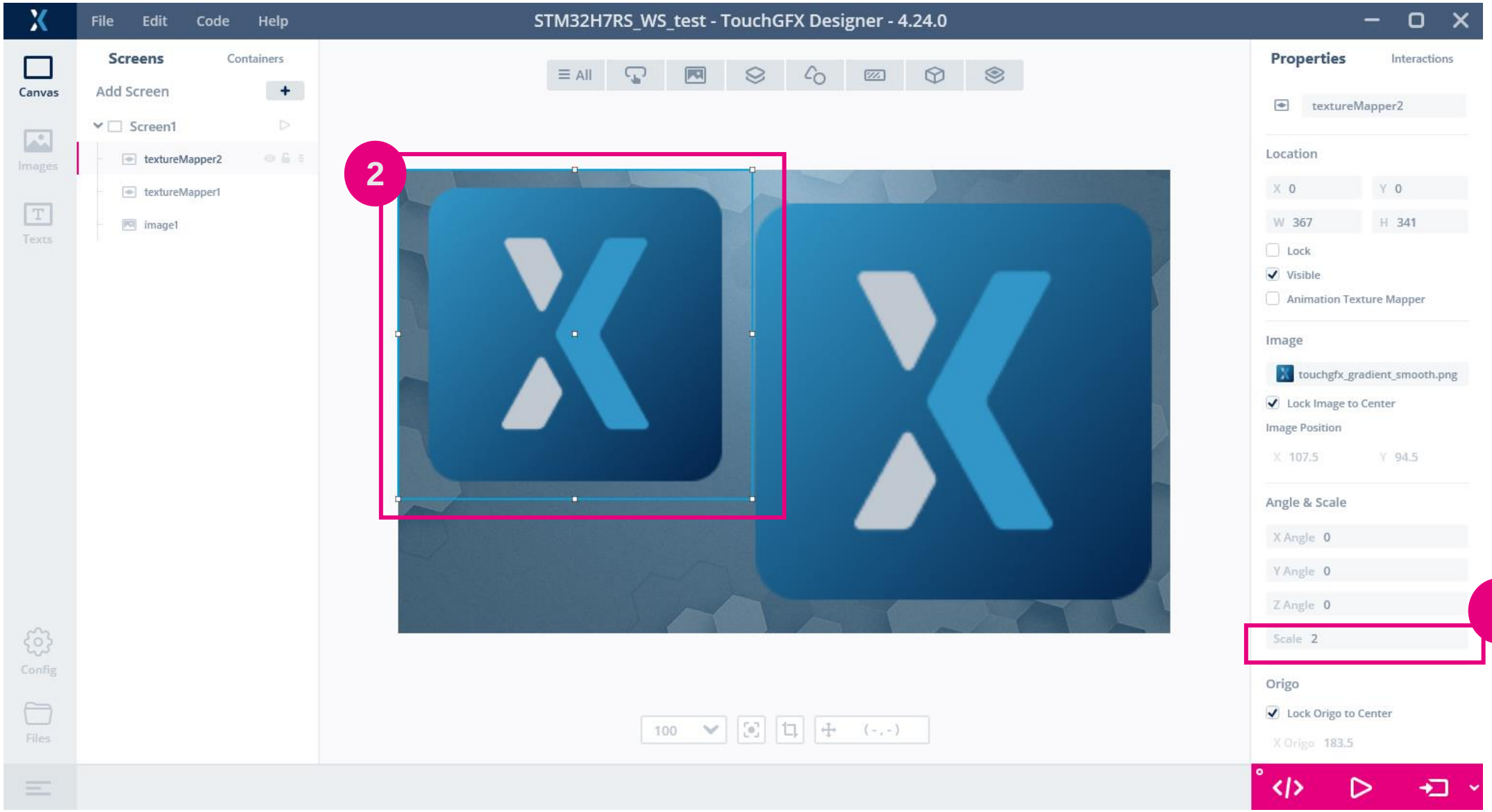
# Insert a texture mapper




life.augmented

TouchGFX 4.24.0 Designer
App

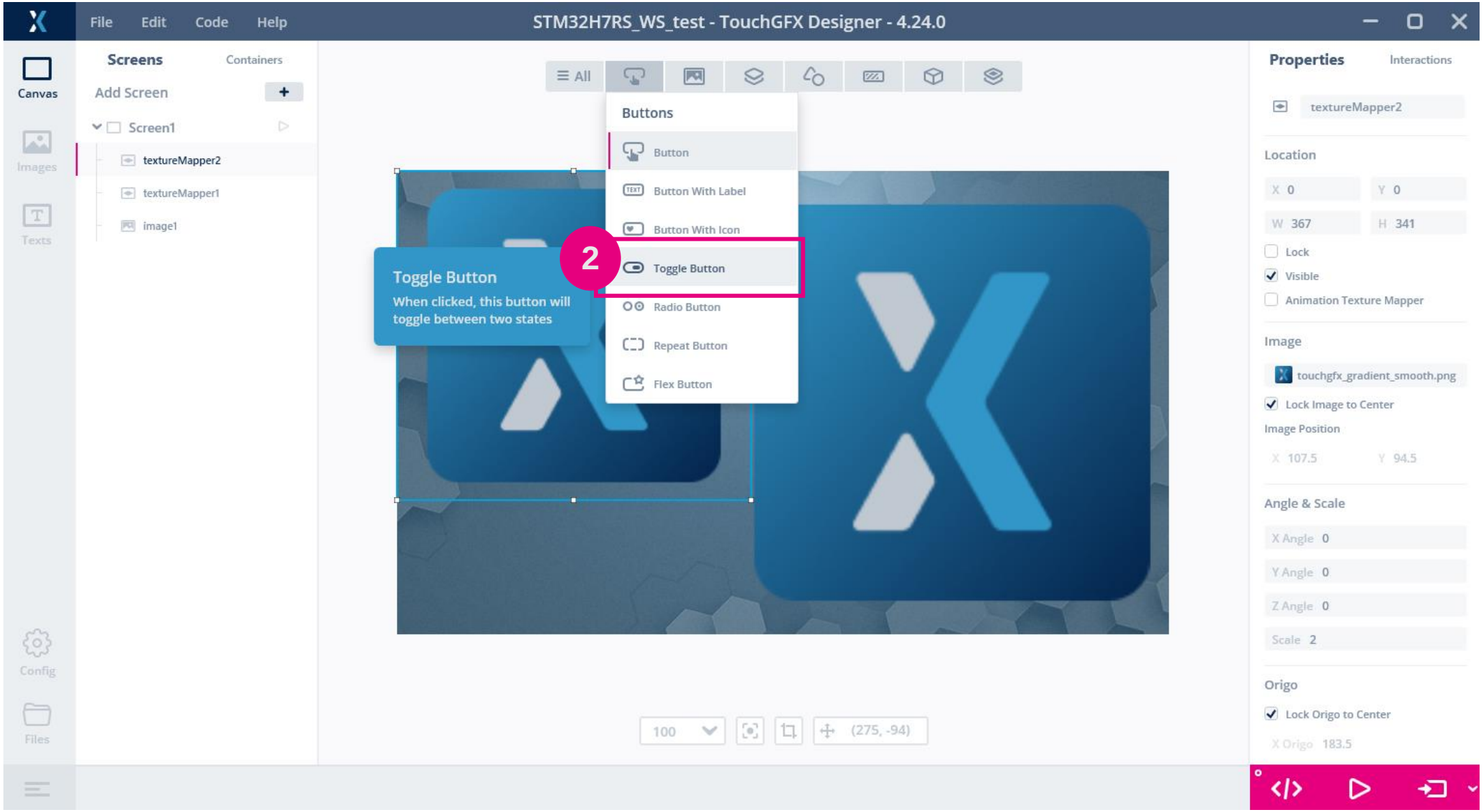
# Increase the size and update location




life.augmented

TouchGFX 4.24.0 Designer
App

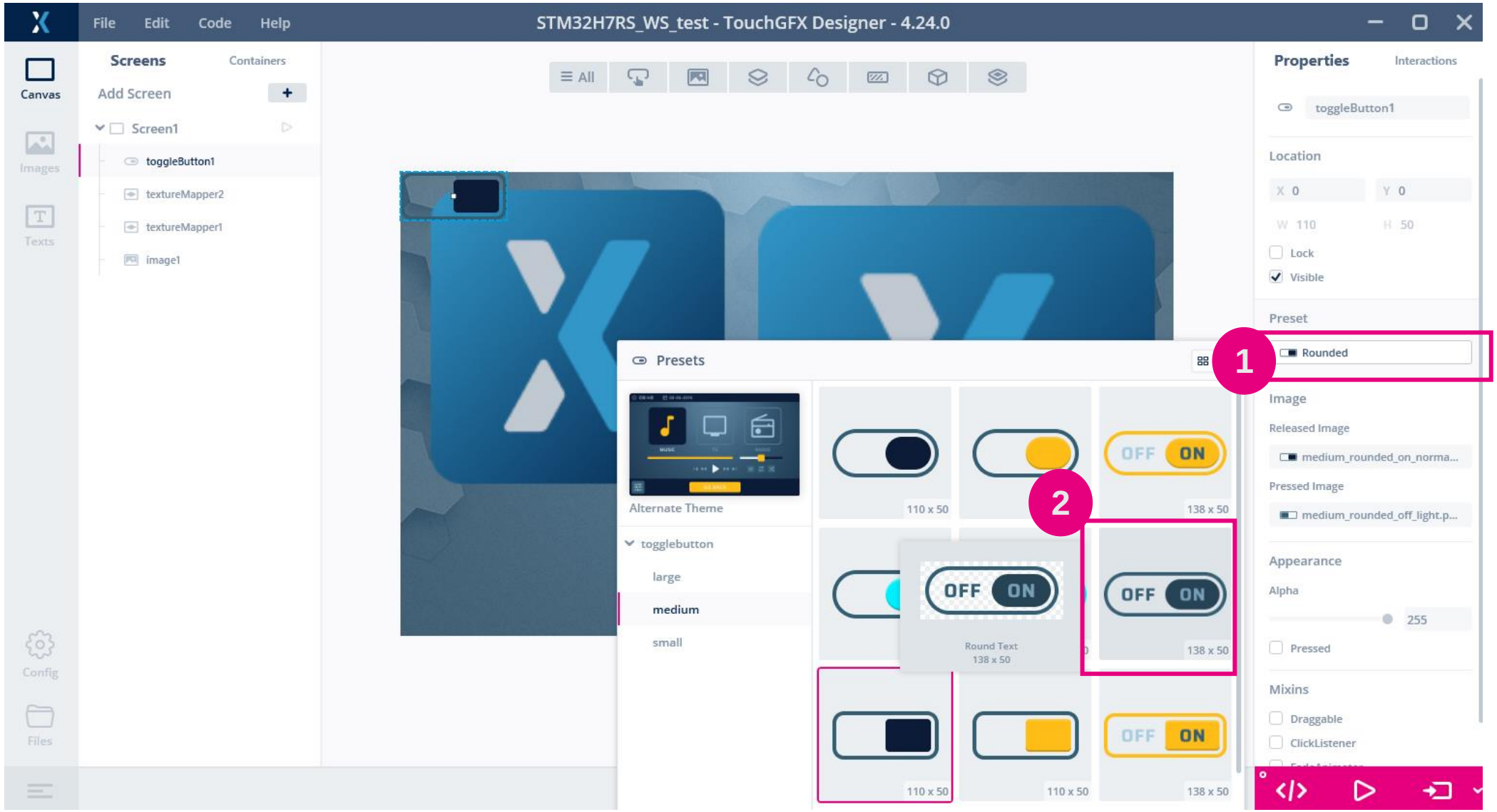
# Add a toggle button




life.augmented

TouchGFX 4.24.0 Designer
App

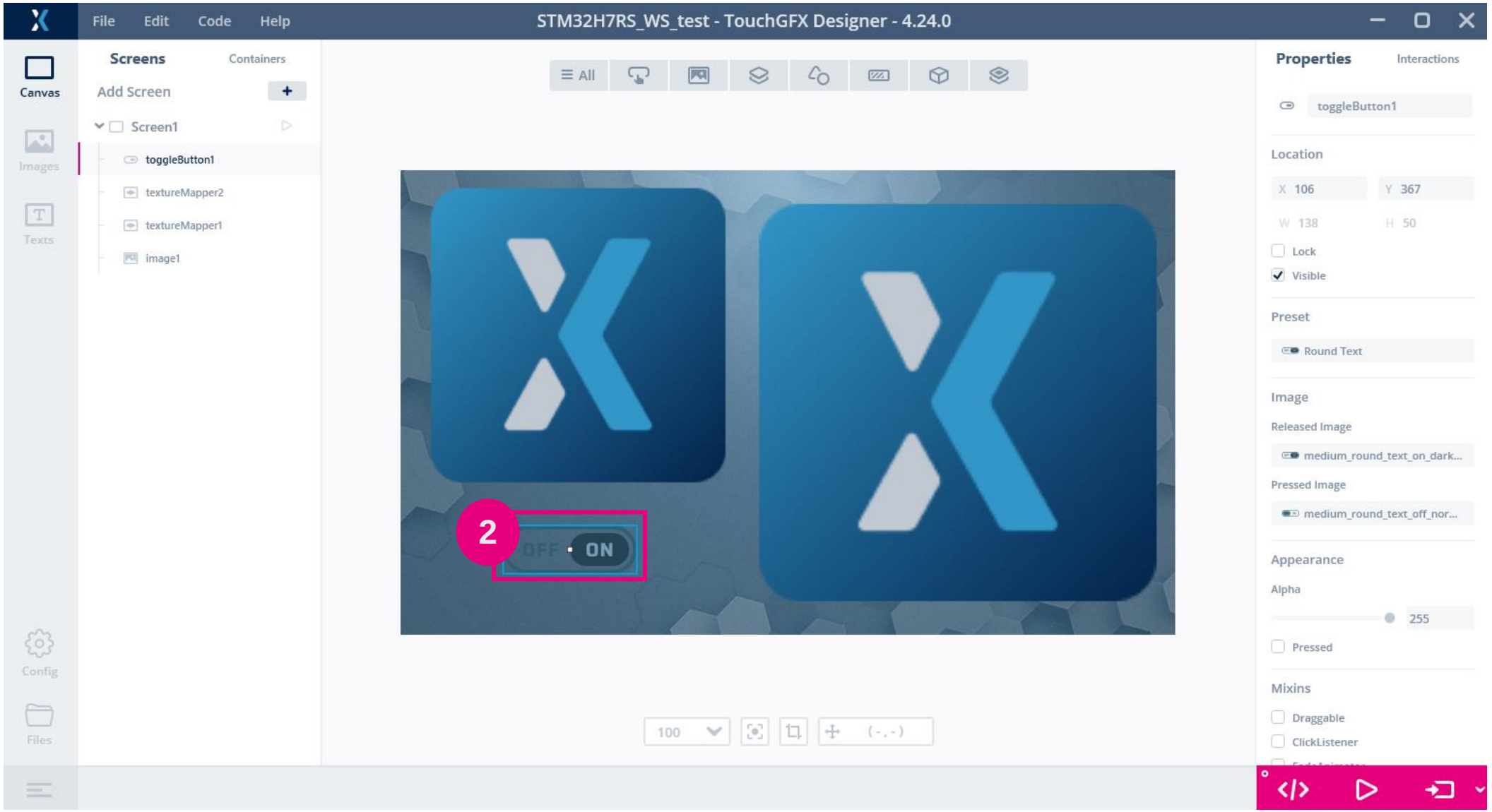
# Customize the button




life.augmented

TouchGFX 4.24.0 Designer
App

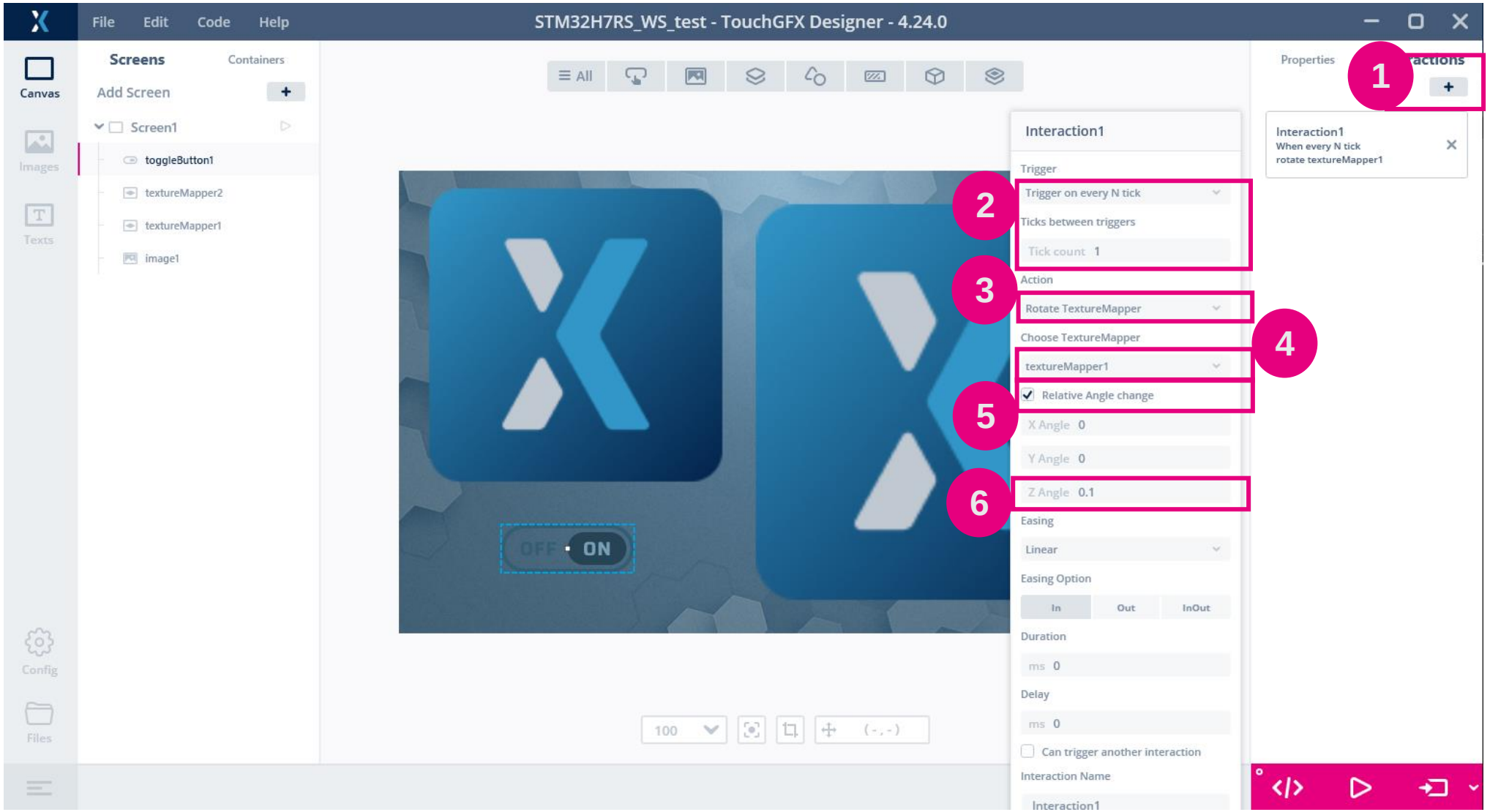
# Update the button location




life.augmented

TouchGFX 4.24.0 Designer
App

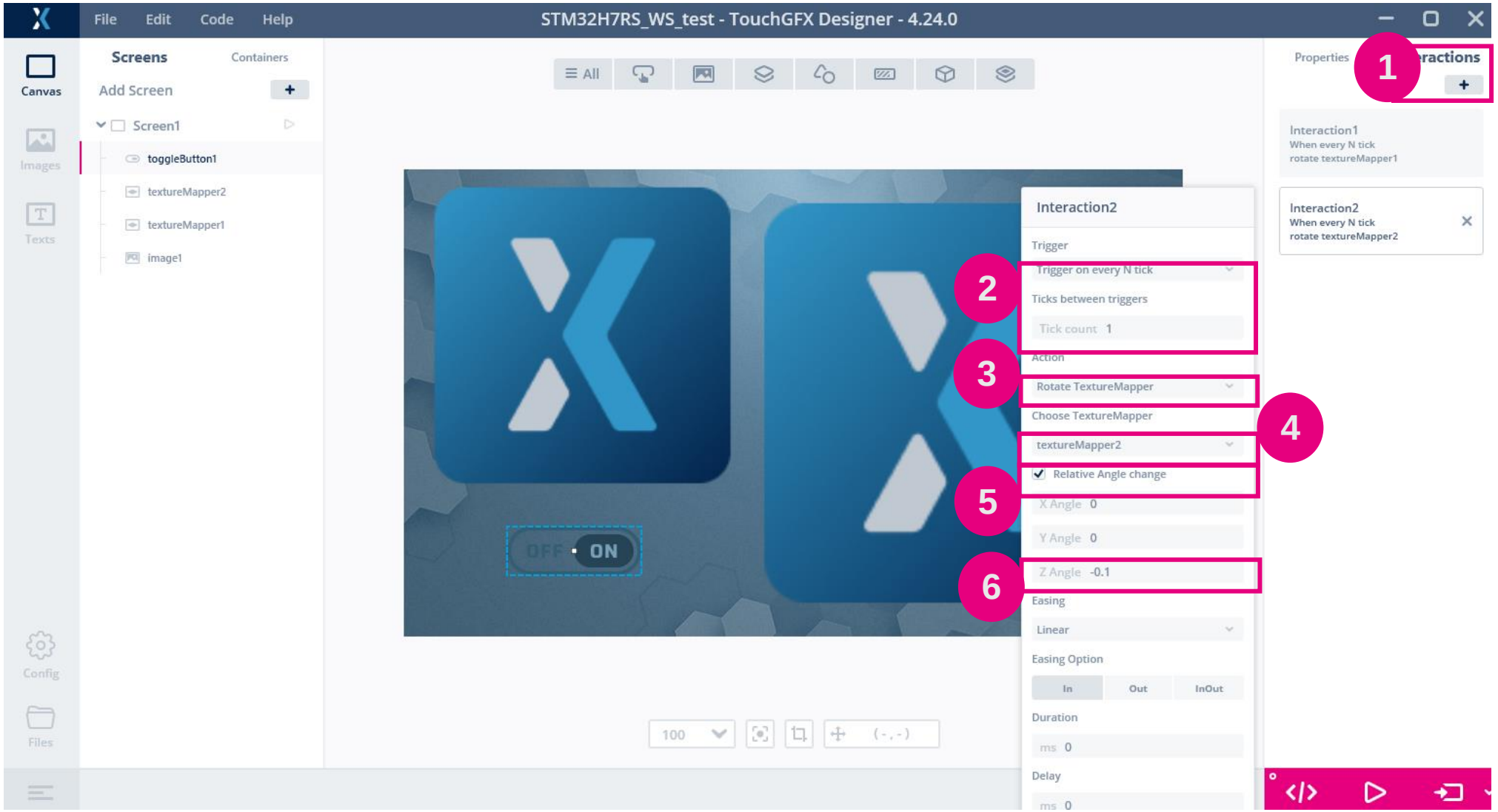
# Rotate the texture mapper 1




life.augmented

TouchGFX 4.24.0 Designer
App

# Rotate the texture mapper 2




life.augmented

# Copy the code to activate / deactivate NeoChrom

## From STM32H7RSWorkShop-Benefit_of_NeoChrom_Demo git

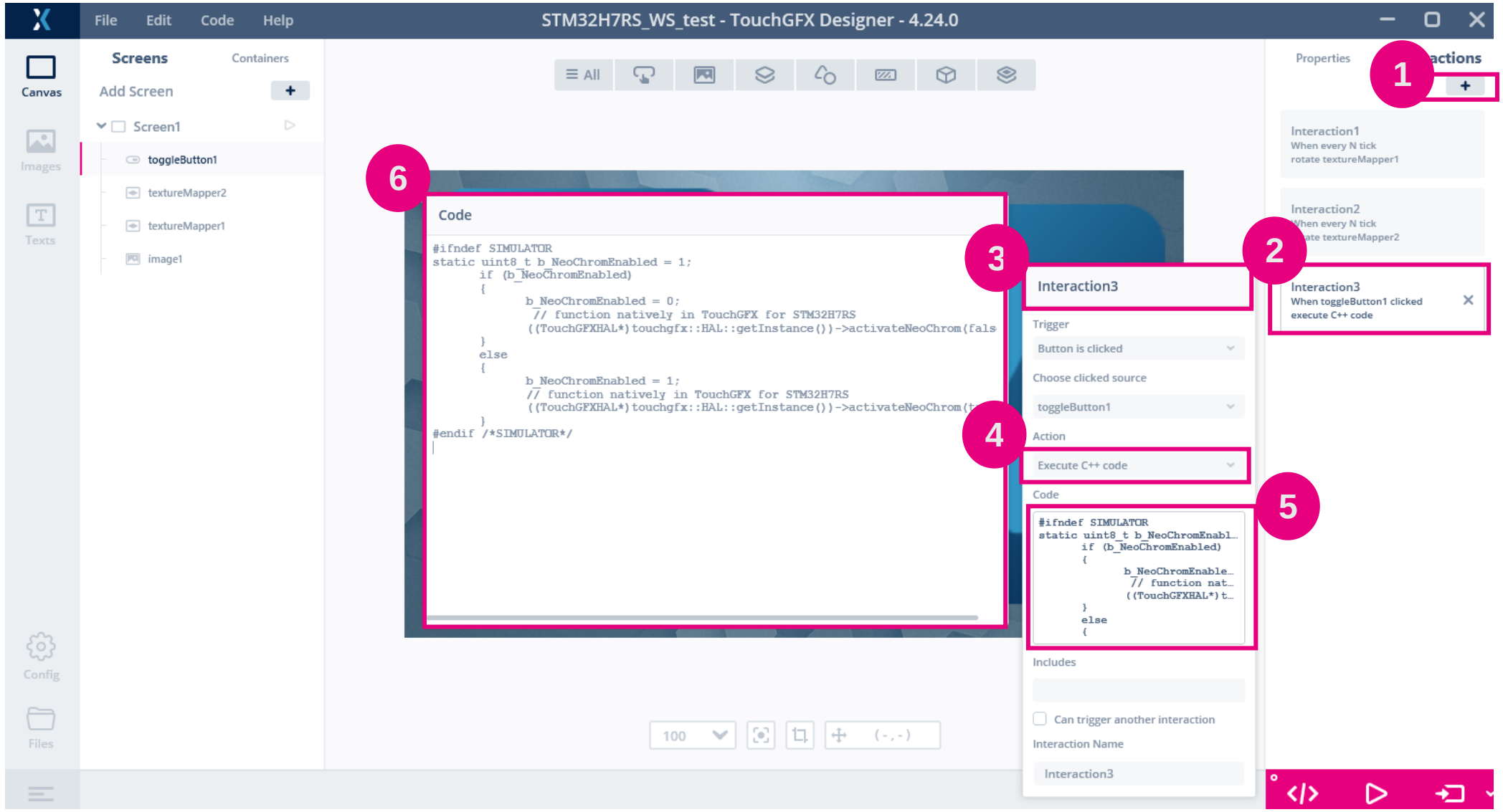
https://github.com/ST-TOMAS-Examples-Gfx/stm32h7rs_touchgfx_neochrom_benefit?tab=readme-ov-file#23-add-the-activation--deactivation-of-neochrom

```
#ifndef SIMULATOR
static uint8_t b_NeoChromEnabled = 1;
        if (b_NeoChromEnabled)
        {
                b_NeoChromEnabled = 0;
                 // function natively in TouchGFX for STM32H7RS
                ((TouchGFXHAL*)touchgfx::HAL::getInstance())->activateNeoChrom(false);
        }
        else
        {
                b_NeoChromEnabled = 1;
                // function natively in TouchGFX for STM32H7RS
                ((TouchGFXHAL*)touchgfx::HAL::getInstance())->activateNeoChrom(true);
        }
#endif /*SIMULATOR*/
```

life.augmented

TouchGFX 4.24.0 Designer
App

# Paste the code to activate / deactivate NeoChrom




life.augmented

# Copy the include to activate / deactivate NeoChrom

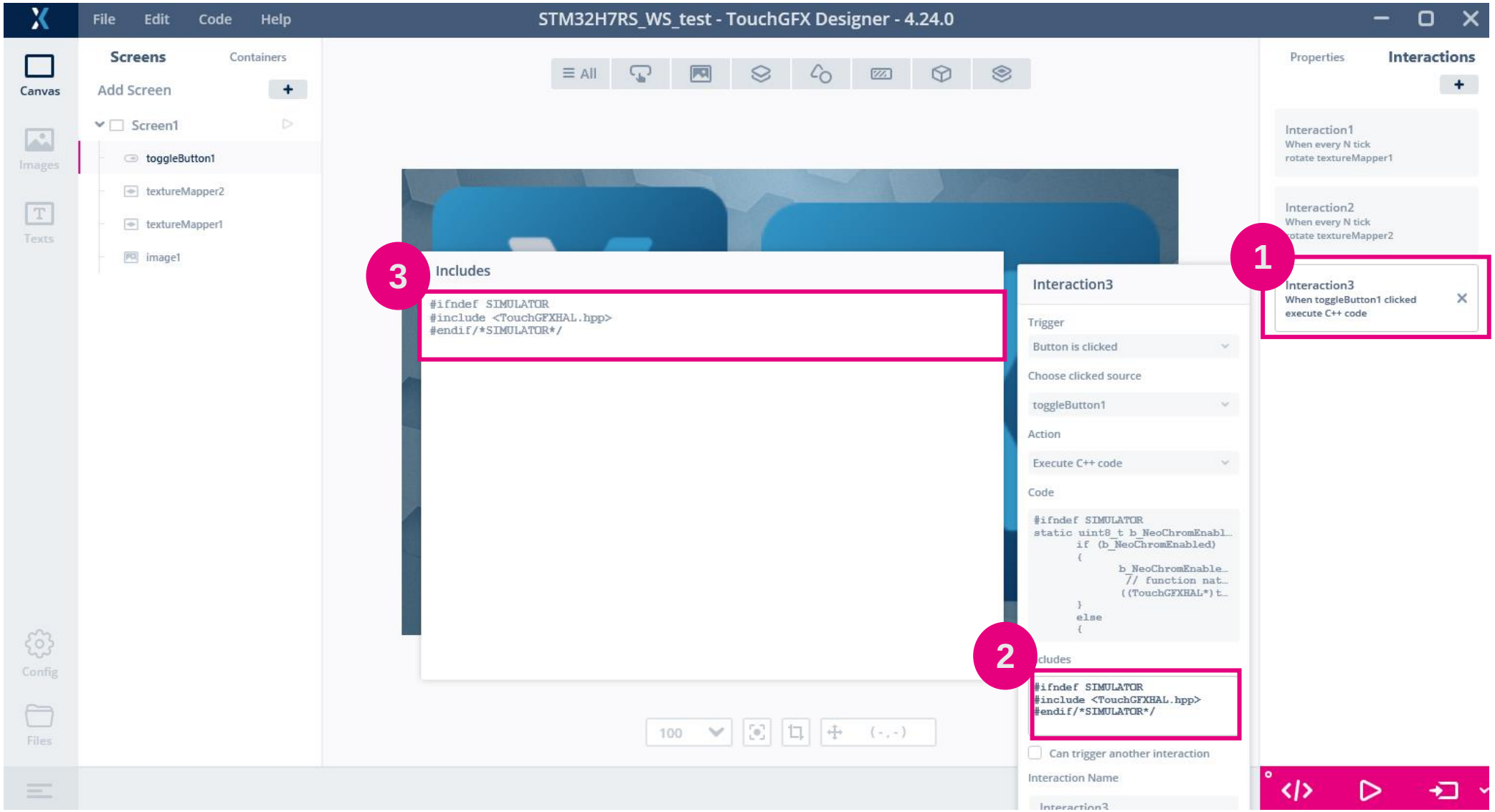
From STM32H7RSWorkShop-Benefit_of_NeoChrom_Demo git

https://github.com/ST-TOMAS-Examples-Gfx/stm32h7rs_touchgfx_neochrom_benefit?tab=readme-ov-file#23-add-the-activation--deactivation-of-neochrom

```
#ifndef SIMULATOR
#include <TouchGFXHAL.hpp>
#endif/*SIMULATOR*/
```

TouchGFX 4.24.0 Designer
App

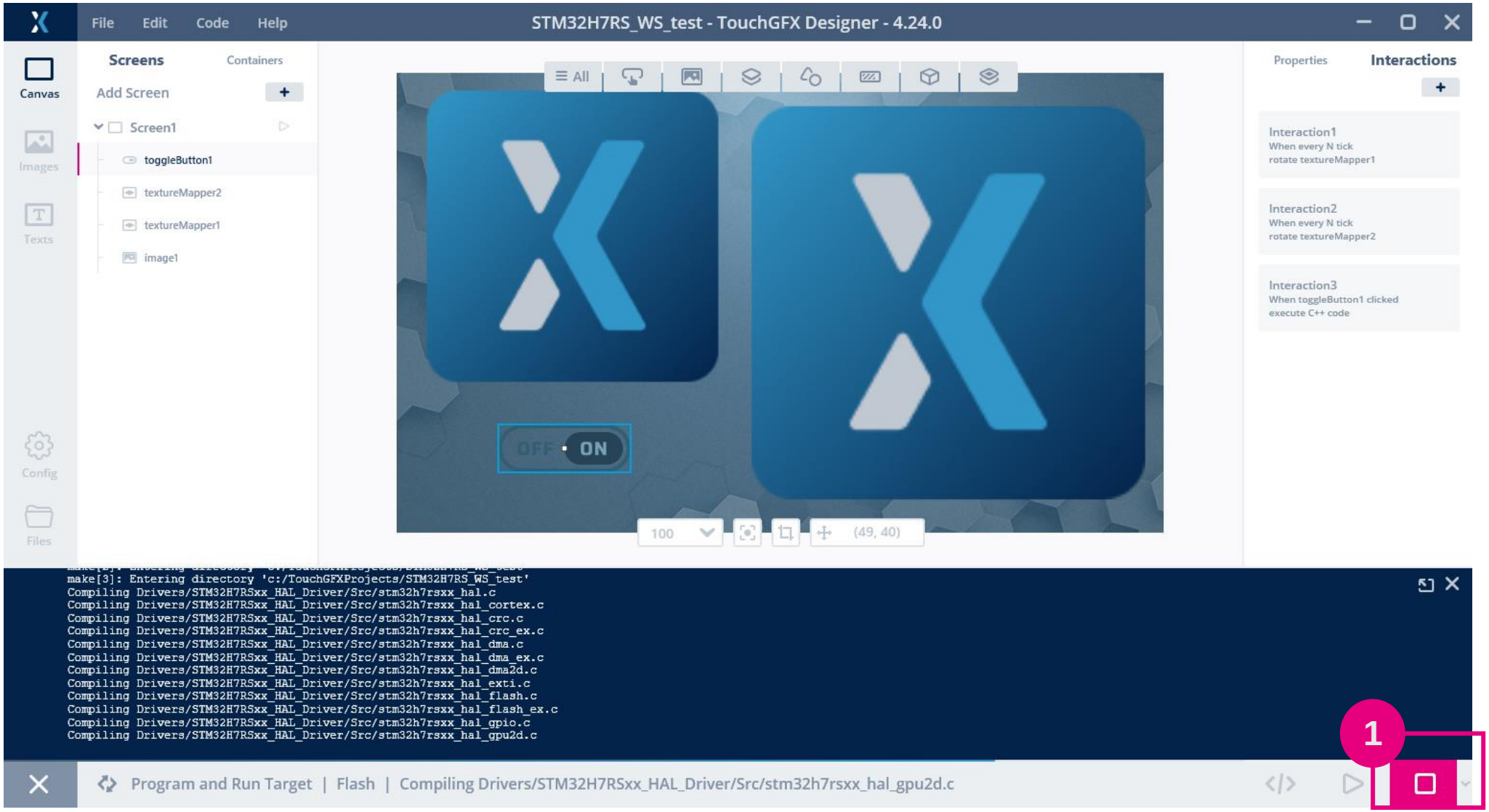
# Paste the include to activate / deactivate NeoChrom




life.augmented

TouchGFX 4.24.0 Designer
App

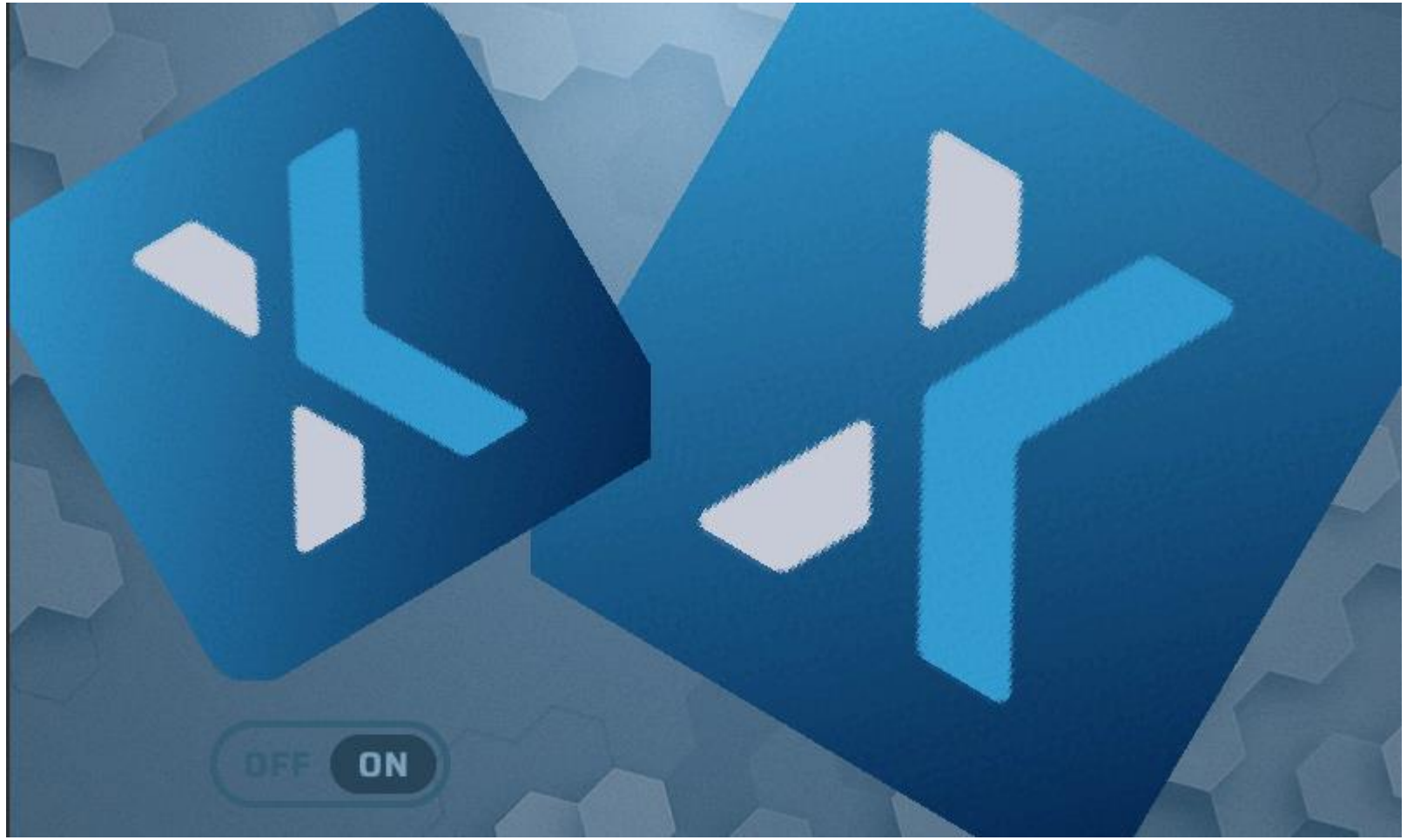
# Generate and download to the target




life.augmented

TouchGFX 4.24.0 Designer
App

# Expected result




Rotation speed should slow down when NeoChrom is deactivated.

life.augmented

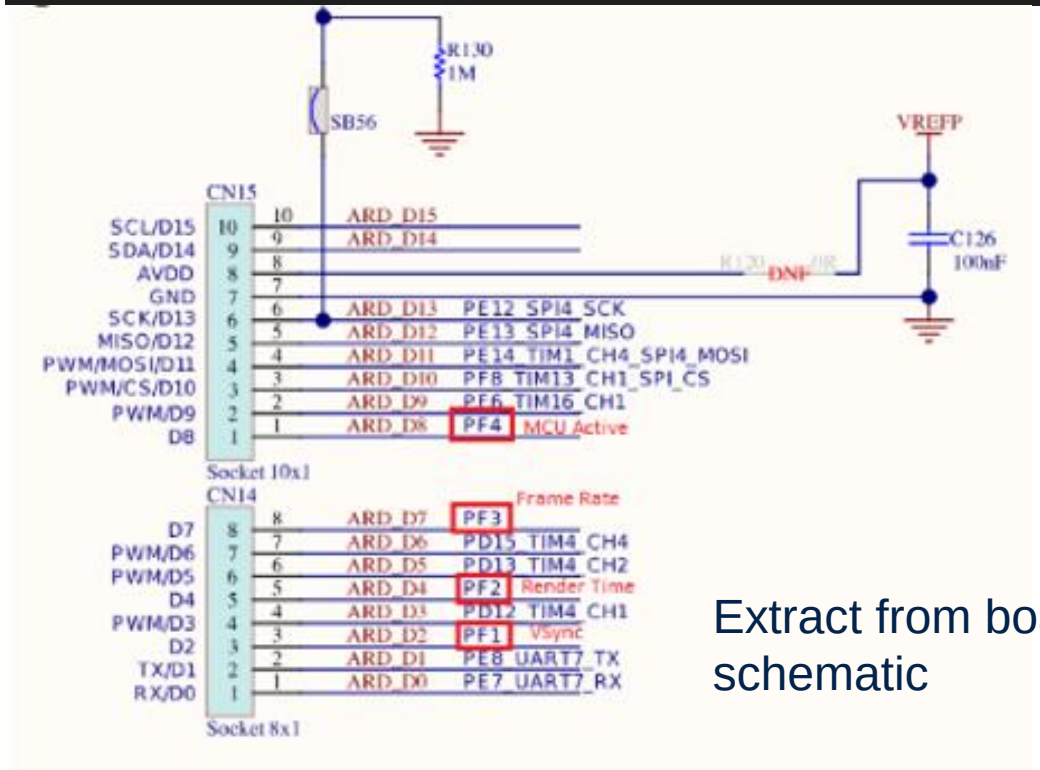
TouchGFX 4.24.0 Designer
App

# An other way to check MCU activity and platform activity ?

## STM32H7S78-DK TBS

Performance testing can be done using the GPIO pins designated with the following signals in CN10 connector on the underside of the board:

- VSYNC_FREQ - CN14-D2 (PF1)
- RENDER_TIME - CN14-D4 (PF2)
- FRAME_RATE - CN14-D7 (PF3)
- MCU_ACTIVE - CN15-D8 (PF4)



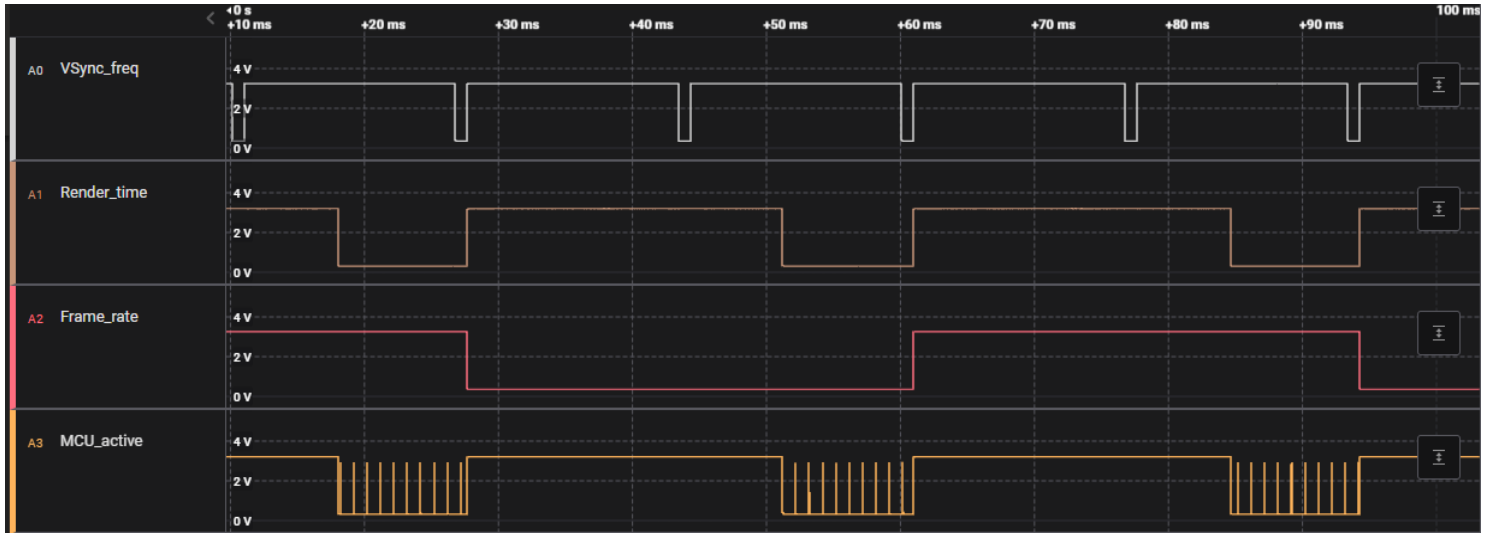

Extract from board schematic

life.augmented

TouchGFX 4.24.0 Designer
App

# Let measure the benefit of NeoChrom

NeoChrom OFF



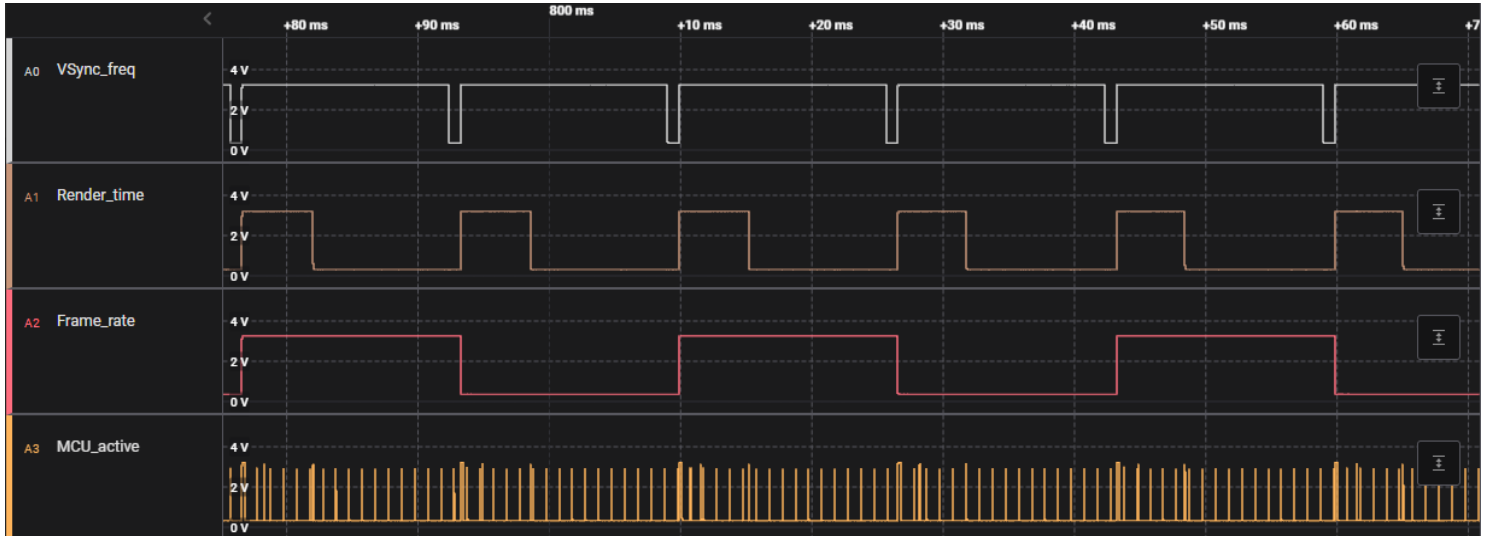

VSync_Freq

Rendering time

Frame rate

MCU active

NeoChrom ON




VSync_Freq

Rendering time

Frame rate

MCU active

life.augmented

# TouchGFX Take-Aways!

- STM32H7RS boot flash allows to select  the external RAM / FLASH which fits your graphic UI requirement.
- The integration of NeoChrom 2.5D graphic accelerator allows to have an advanced GUI application without loading the Cortex M7 at 600 MHz
- STM32H7S78-DK is delivered with nice demonstration software which demonstrate the platform capabilities!
- On top of that, TouchGFX designer associated with STM32H7S78-DK allows to create prototype of your UI and evaluate the benefit of the overall STM32H7RS architecture !

# Our technology starts with You

Find out more at www.st.com



life.augmented