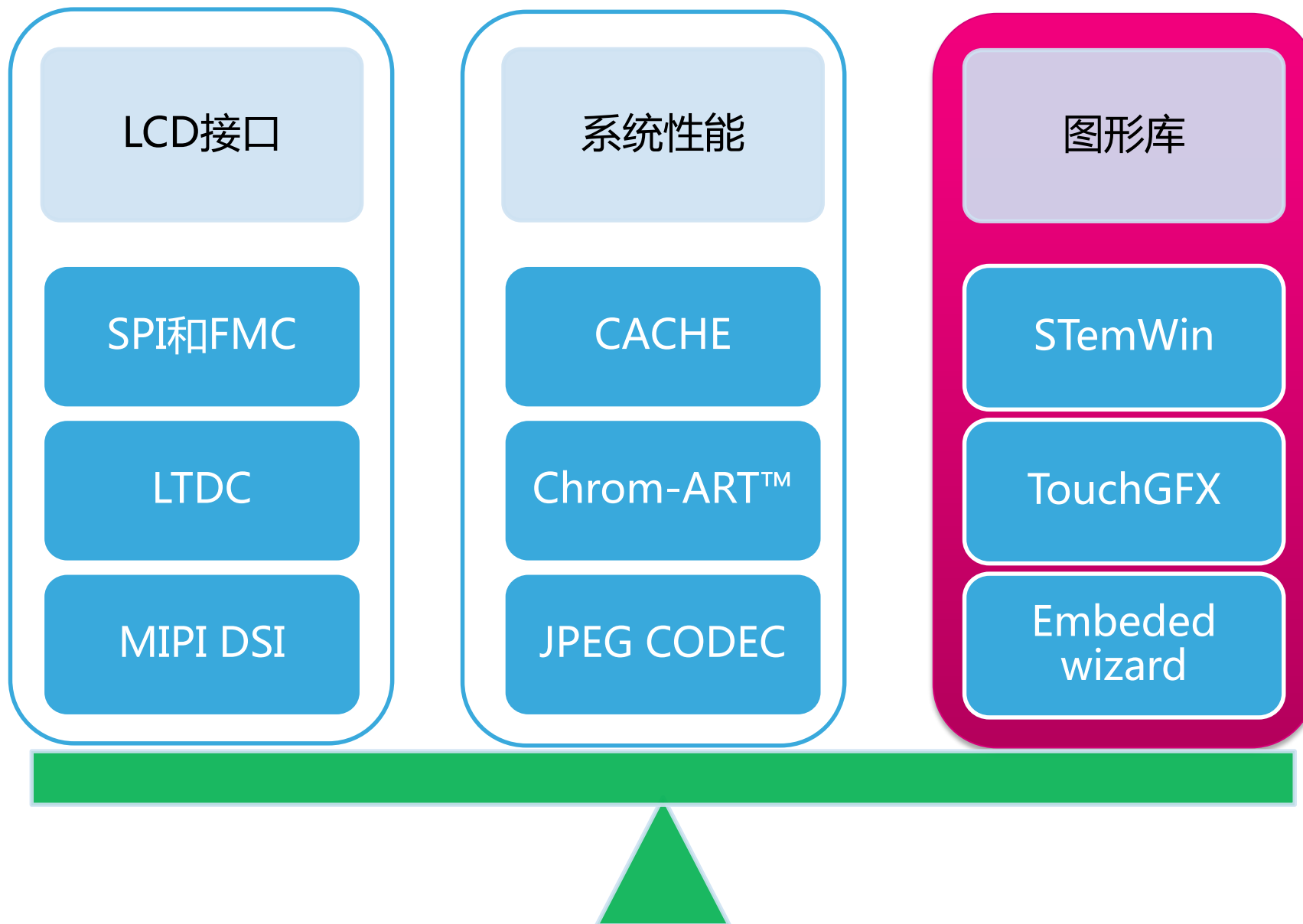


使用STM32 设计HMI-软件

介绍使用STM32提供的硬件资源和软件资源开发人机交互界面HMI的方法

提供了丰富的图形库,加速用户界面开发

2



可用于STM32的图形协议栈

3

STemWin **FREE**



TouchGFX



Embedded Wizard



免费方案

付费方案

STM32GUI软件方案图形库特性

4



多国语言支持



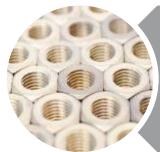
易移植外设驱动架构



完整的特性列表



丰富的GUI例程



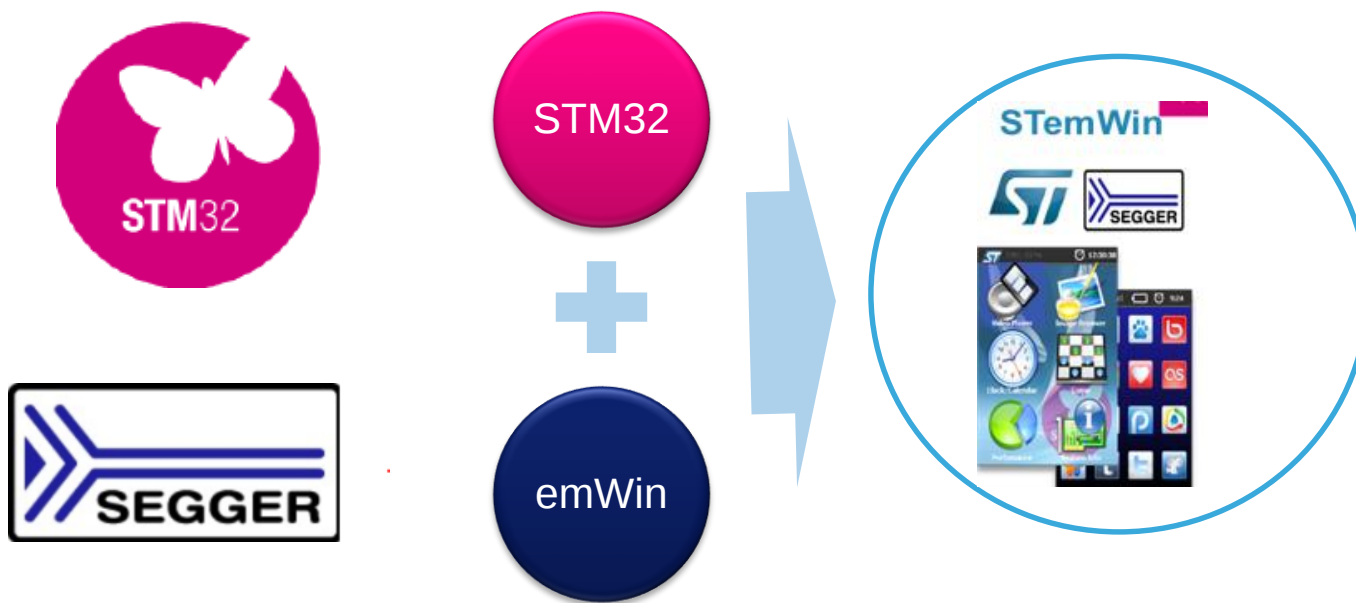
绘制UI工具集

图形库提供的功
能和特性

STM32 GUI 软件方案介绍

- STemWin
- TouchGFX
- Embeddedwizard

- ST和Segger联合开发的嵌入式GUI方案
- STemWin高度可裁剪可移植,支持全系列STM32
- STemWin对于STM32的用户是**免费**的



STemWin介绍

- 2D图像库

- 丰富的矢量绘图API
- 图像显示功能 (bmp、jpeg、png、gif)

- 多种字体

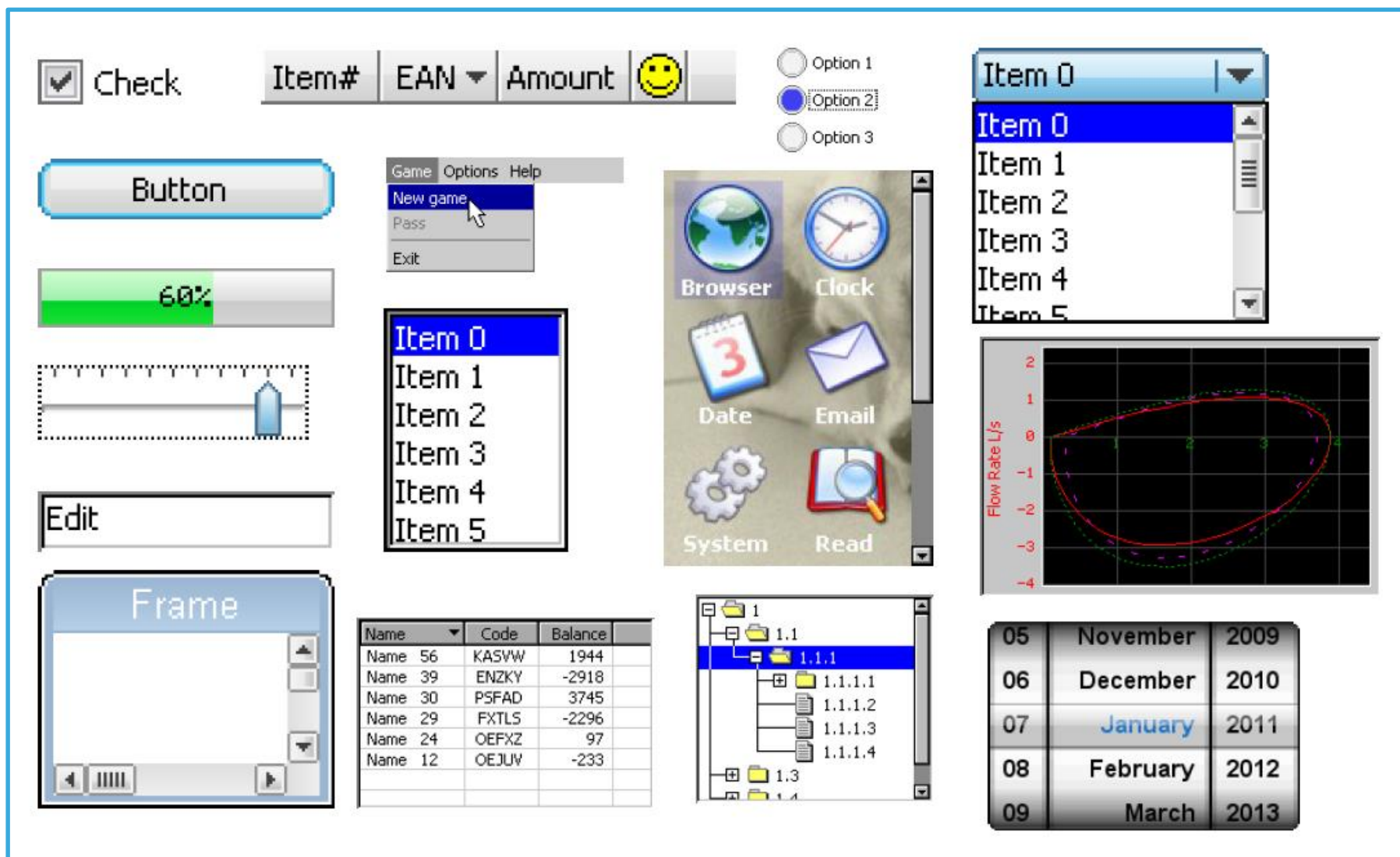
- 可导入用户字体
- 支持多国语

Albanian	German	Russian
Arabic	Greek	Slovak
Bulgarian	Hungarian	Spanish
Chinese (simplified)	Indonesian	Swedish
<u>Chinese (Traditional)</u>	Italian	Thai
Czech	Japanese	Turkish
Danish	Malay	Ukrainian
Dutch	Norwegian	Vietnamese
English	Polish	还有更多...
Finnish	Portuguese	
French	Romanian	

- 支持嵌入式操作系统
- 清晰的驱动接口，方便用户快速移植LCD驱动、存储设备
- 提供从简单到复杂的丰富的例程
 - 快速上手
 - 加快新应用开发速度
 - STemWIN包含120多个例程

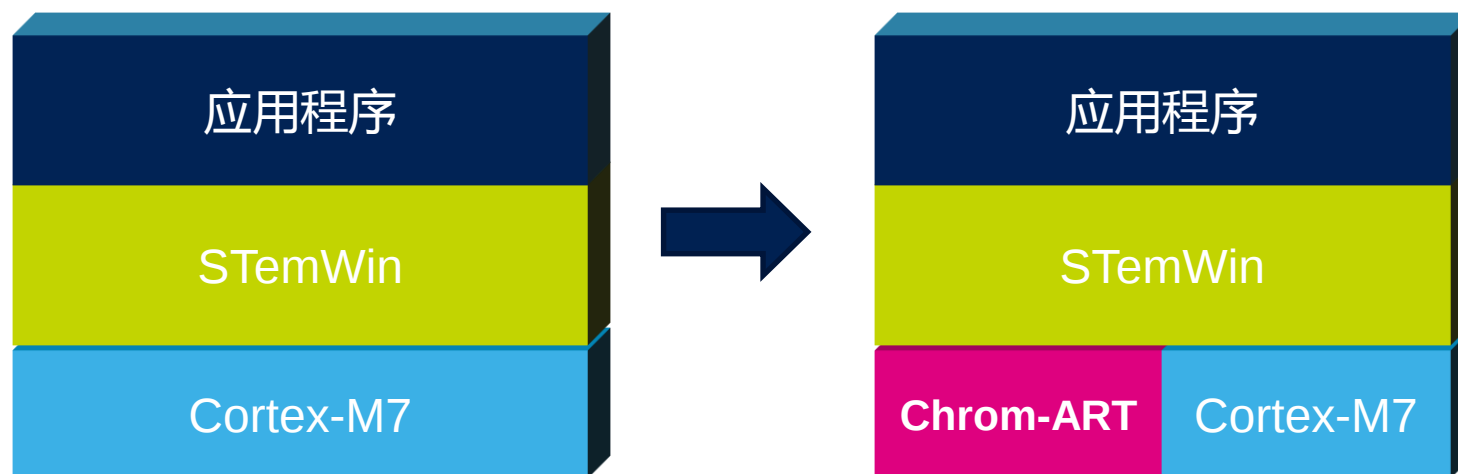
丰富美观的GUI控件

9



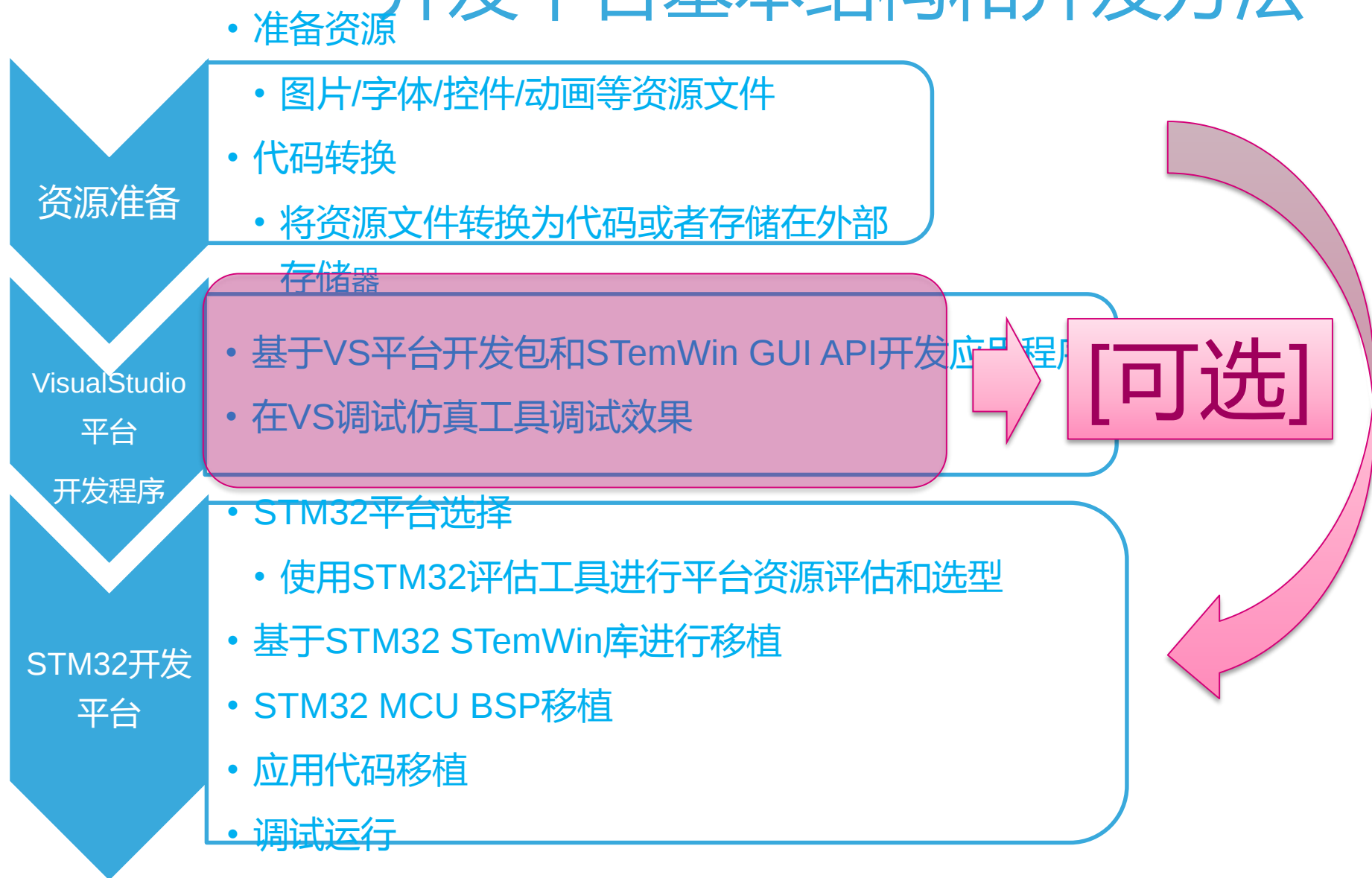
STemWin支持Chrom-ART

10



- **Chrom-ART** 对于应用程序是透明的
- STemWin底层驱动使用**Chrom-ART**进行数据传送，像素格式转换和合成
- **降低CPU负载并加快图形操作速度**

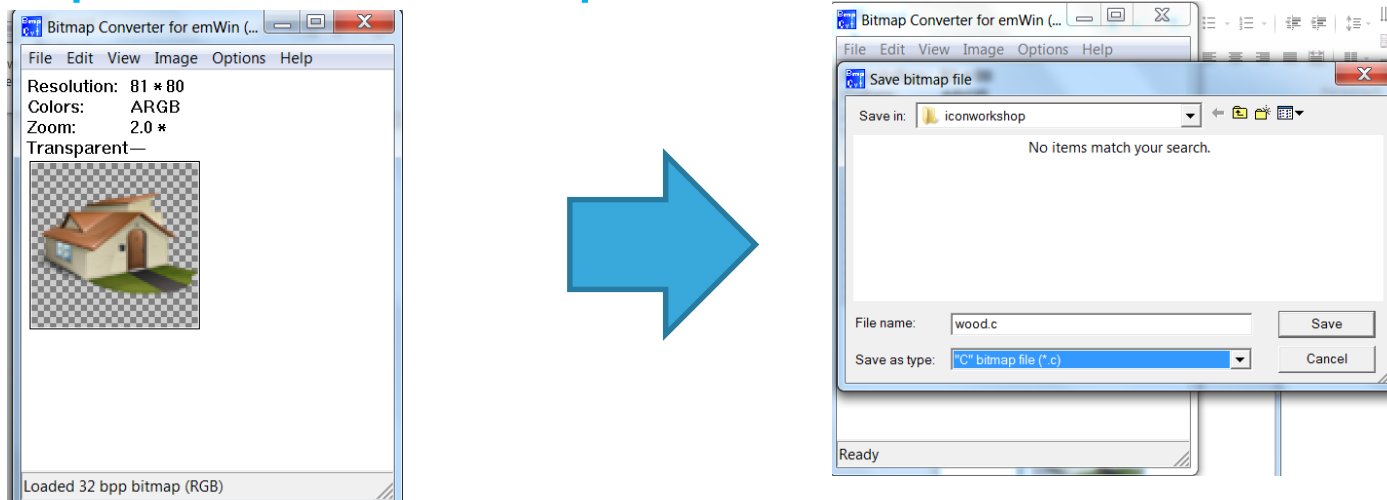
开发平台基本结构和开发方法



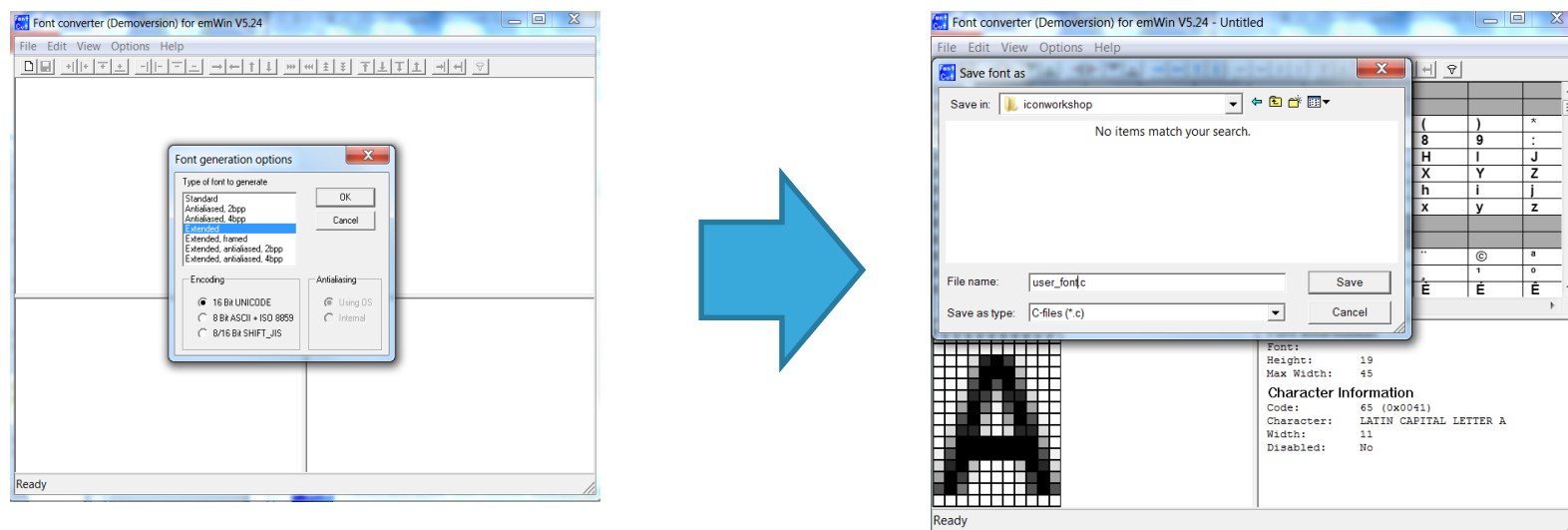
资源准备(举例)-图片/字体资源处理

12

- BitmapConverter将bmp图片资源生成相应的.c文件

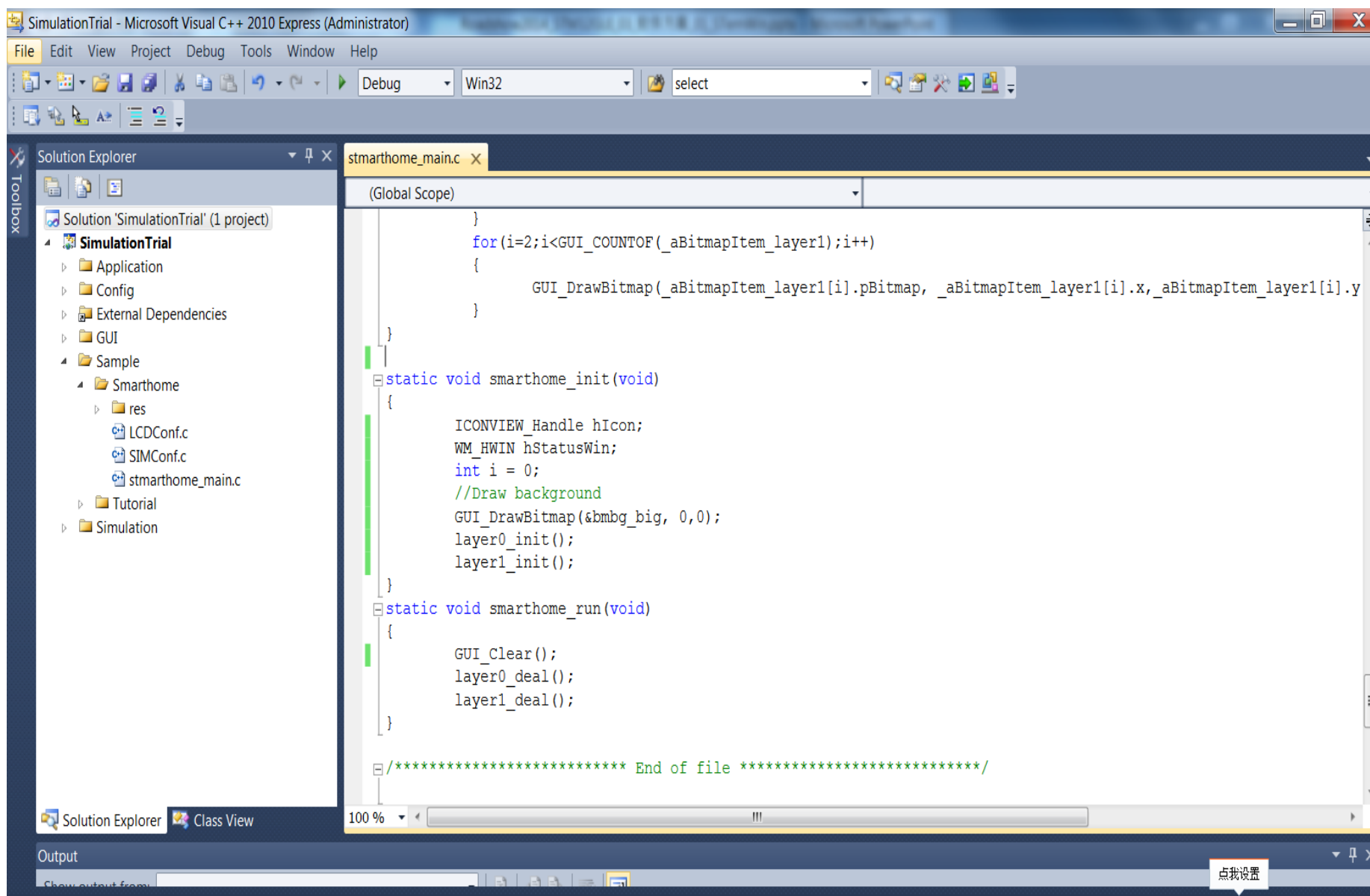


- FontConverter将字体文件资源生成相应的.c文件

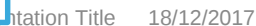


使用VisualStudio开发应用程序（可选）

13



14



STemWin例程演示视频

16



STM32GUI软件方案

STemWin Demo演示



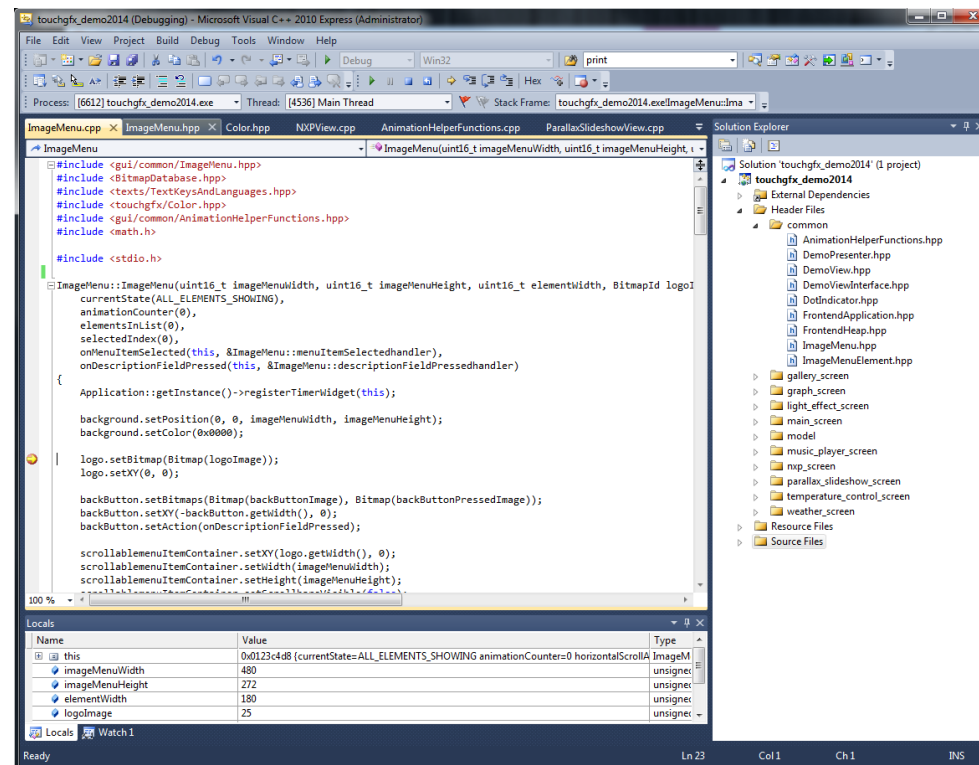
STM32 GUI 软件方案介绍

- STemWin
- TouchGFX
- Embeddedwizard

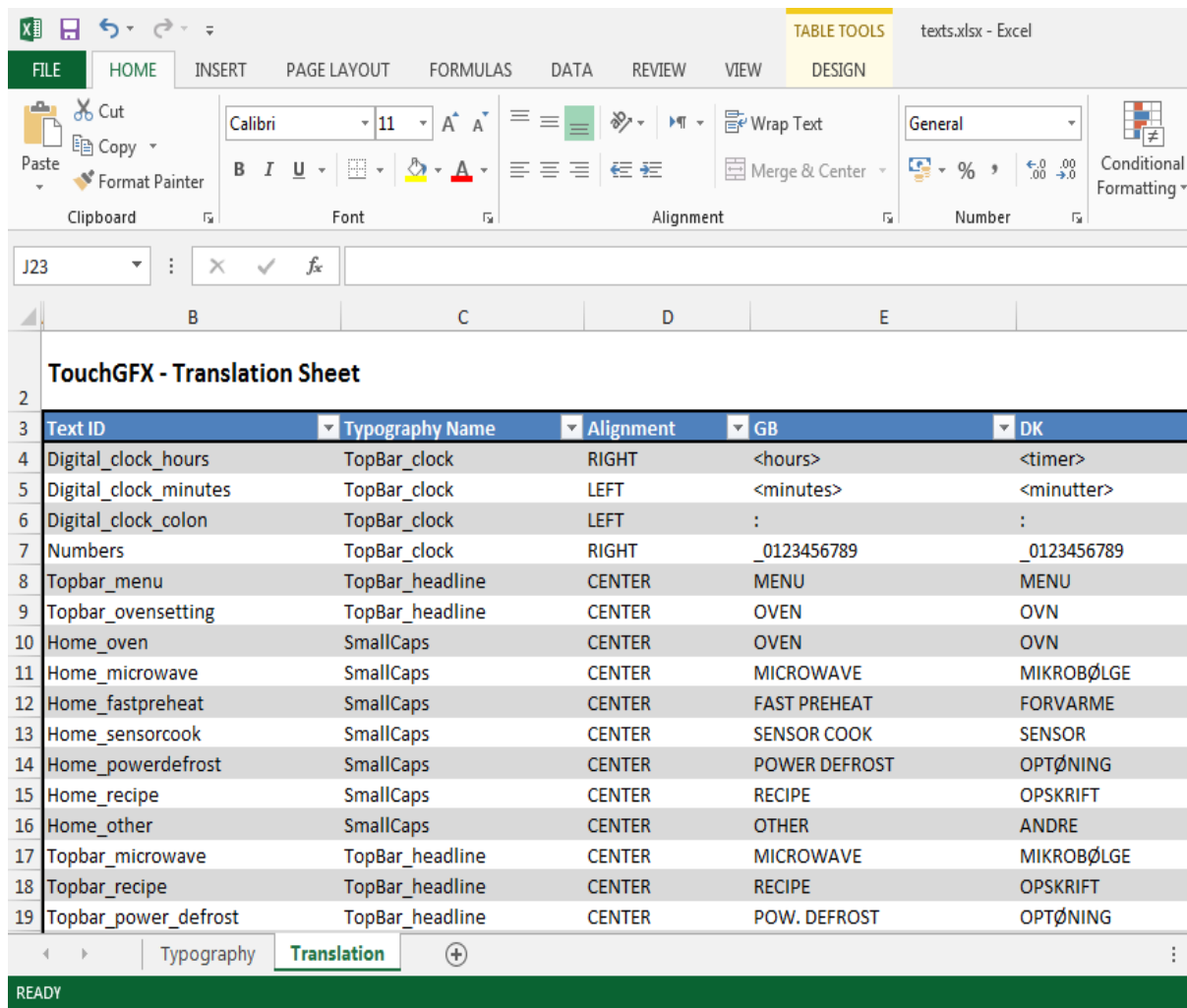
- 提供智能手机风格的用户界面
- 出色的驱动
 - 融合STM32 Chrom-ART™专利技术
 - 更加出色的性能和更低的CPU占用率
 - 高刷新率提升动画流畅度增强用户体验
- 软件特性
 - 普通功能
 - Alpha混合
 - 抗锯齿字体和间距控制
 - 文字旋转
 - 多国语言
 - 特效功能
 - 触摸手势
 - 2D/3D旋转和缩放



- 基于C++平台
 - 面向对象编程
 - 独立的硬件抽象层便于平台移植
- 开发环境
 - 模拟器可以运行在微软Visual Studio和GCC
 - 平台支持IAR, Keil, GCC



- Font Converter
 - TrueType字体
- Image Converter
 - PNG, BMP
- 基于Excel的文字数据库和
多语言支持
 - 方便不同部门协同合作



Text ID	Typography Name	Alignment	GB	DK
Digital_clock_hours	TopBar_clock	RIGHT	<hours>	<timer>
Digital_clock_minutes	TopBar_clock	LEFT	<minutes>	<minutter>
Digital_clock_colon	TopBar_clock	LEFT	:	:
Numbers	TopBar_clock	RIGHT	_0123456789	_0123456789
Topbar_menu	TopBar_headline	CENTER	MENU	MENU
Topbar_ovensetting	TopBar_headline	CENTER	OVEN	OVN
Home_oven	SmallCaps	CENTER	OVEN	OVN
Home_microwave	SmallCaps	CENTER	MICROWAVE	MIKROBØLGE
Home_fastpreheat	SmallCaps	CENTER	FAST PREHEAT	FORVARME
Home_sensorcook	SmallCaps	CENTER	SENSOR COOK	SENSOR
Home_powerdefrost	SmallCaps	CENTER	POWER DEFROST	OPTØNING
Home_recipe	SmallCaps	CENTER	RECIPE	OPSKRIFT
Home_other	SmallCaps	CENTER	OTHER	ANDRE
Topbar_microwave	TopBar_headline	CENTER	MICROWAVE	MIKROBØLGE
Topbar_recipe	TopBar_headline	CENTER	RECIPE	OPSKRIFT
Topbar_power_defrost	TopBar_headline	CENTER	POW. DEFROST	OPTØNING



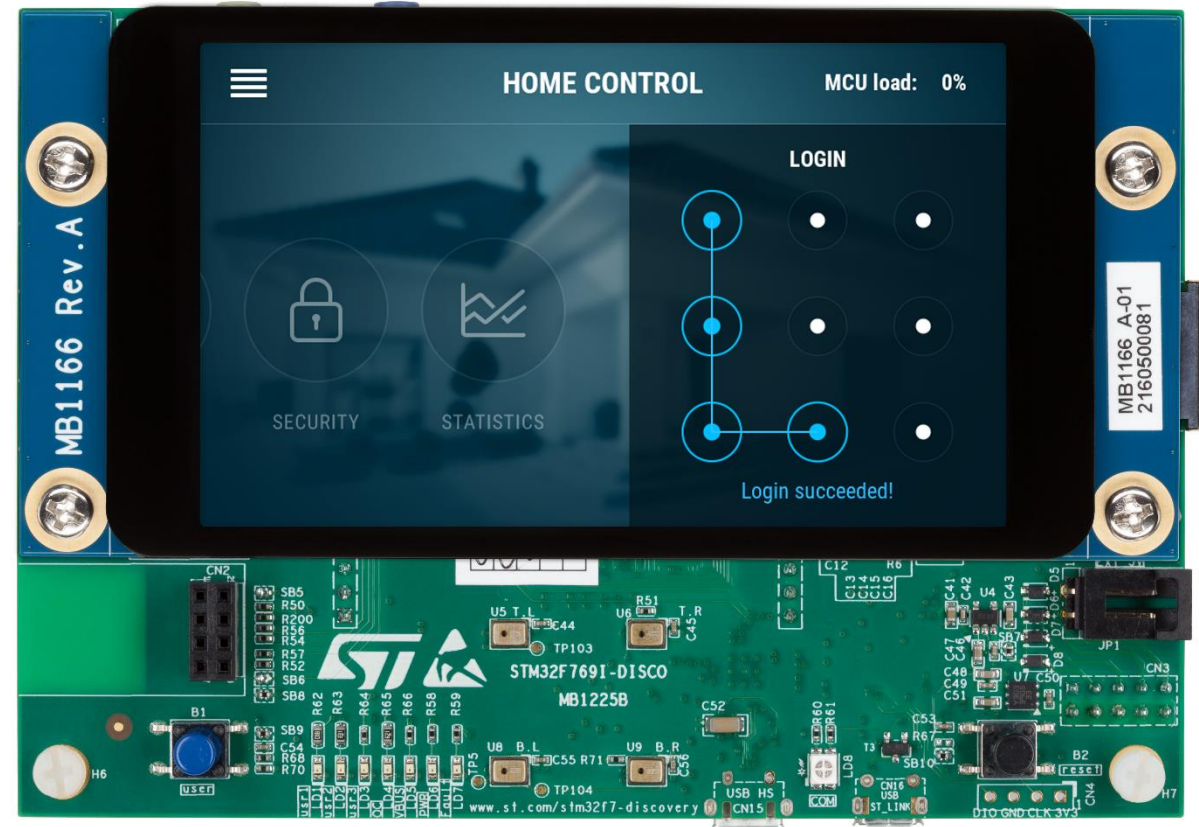
Create Anything

Through easy creation of custom widgets, TouchGFX is your perfect tool for developing one-of-a-kind applications with a smartphone look and feel.



Max UI Performance on STM32

TouchGFX enables astounding smartphone UI performance by full utilization of STM32 advanced graphical hardware features, such as the **Chrom-ART Accelerator™** and **JPEG HW accelerator**.





STM32F4



STM32F4



STM32F105



TouchGFX Development

TouchGFX Tools

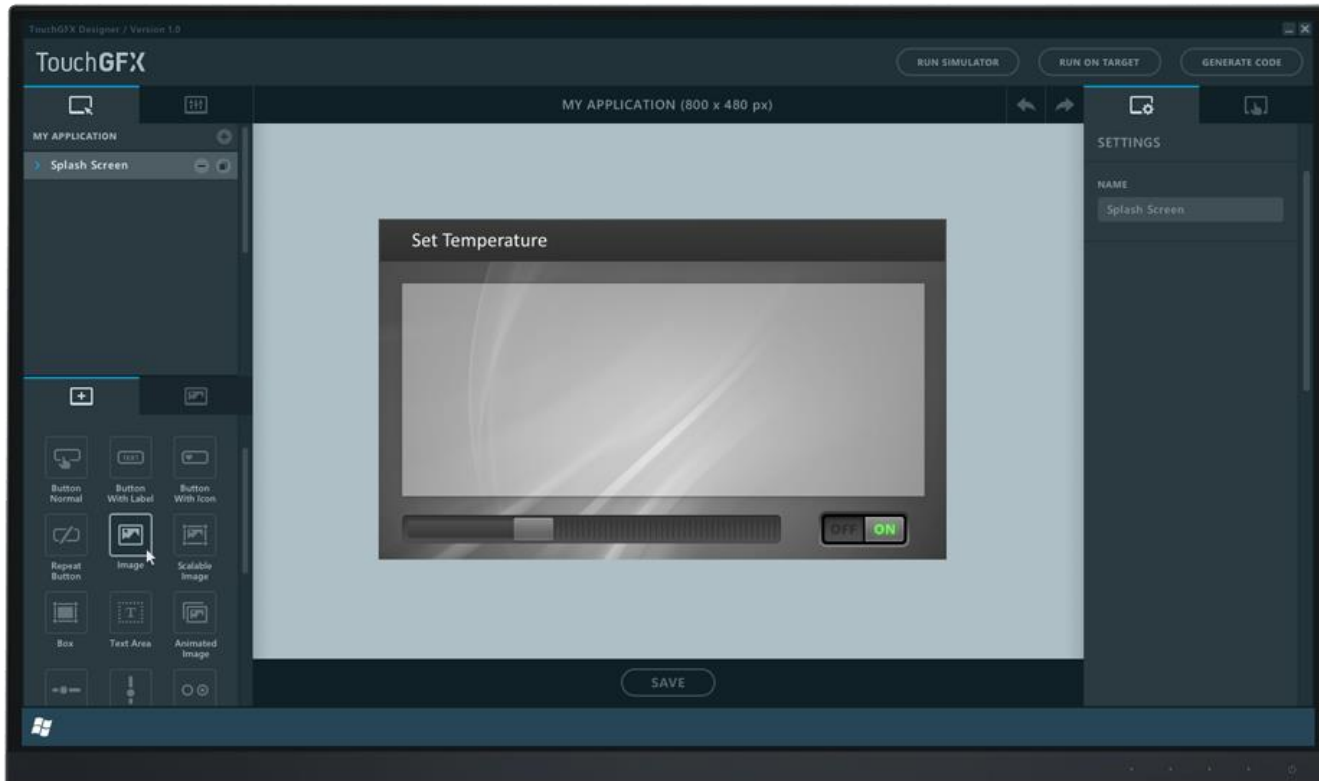
TouchGFX combines the simplicity of a WYSIWYG designer, the efficiency and flexibility of the C++ language with the convenience of a PC simulator to create the perfect environment for developing advanced and rich graphical interfaces, fast.

- **Text Converter**
Manage multiple languages and converts texts and translations into an optimized target format
- **Image Converter**
Converts application images to target format optimized for Chrom-ART acceleration
- **Font Converter**
Converts .ttf font files into target format optimized for the Chrom-ART accelerator™
- **TouchGFX Designer**
WYSIWYG graphical drag and drop tool
- **PC Simulator**
For easy validation and testing of your application during development

TouchGFX Designer

From Prototype to Product

TouchGFX Designer will support you throughout your entire UI project by simplifying the process of creating the visual design and layout of your screens and custom controls. Your TouchGFX application code is automatically updated with the changes done in the Designer.



Creation of screen in TouchGFX Designer

TouchGFX Designer

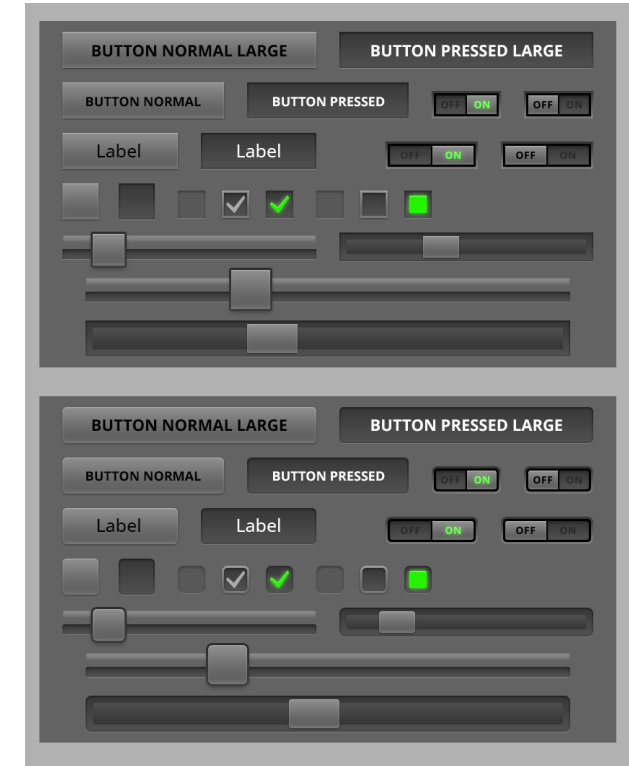
From Idea to Prototype

A simple drag n' drop approach combined with ready-to-use high quality sample graphics enable you to create stunning prototypes in minutes with no need for advanced design and programming skills or TouchGFX knowledge.

From Prototype to Product

TouchGFX Designer will support you throughout your entire UI project by simplifying the process of creating the visual design and layout of your screens and custom controls.

Your TouchGFX application code is automatically updated with the changes done in the Designer.



Graphics sample



TouchGFX Technology

TouchGFX Technology

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Key Concepts

Advanced Rendering Algorithms

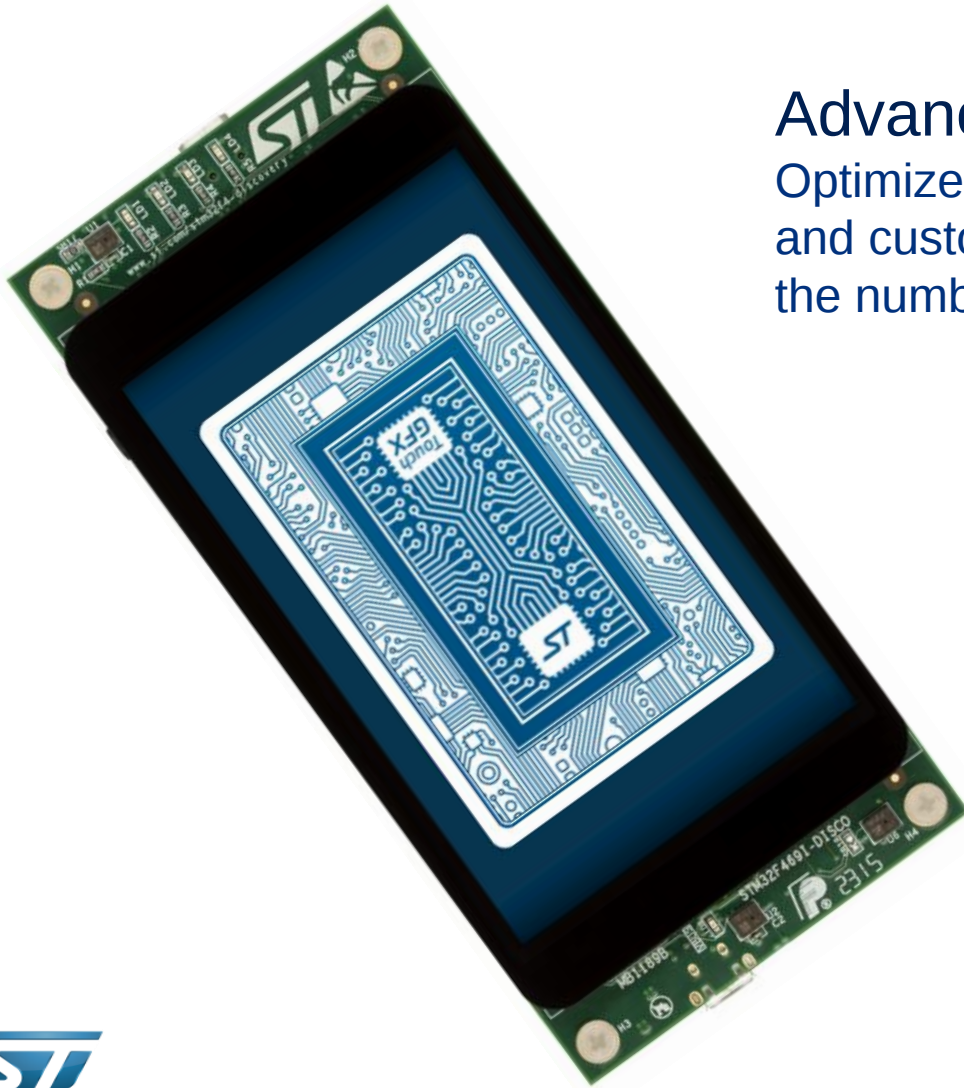
Optimized visible surface determination algorithm and customized invalidation techniques minimize the number of drawn pixels.

Easy Creation of Custom Controls

Create custom controls by extending or modifying existing widgets or by combining existing controls with custom functionality.

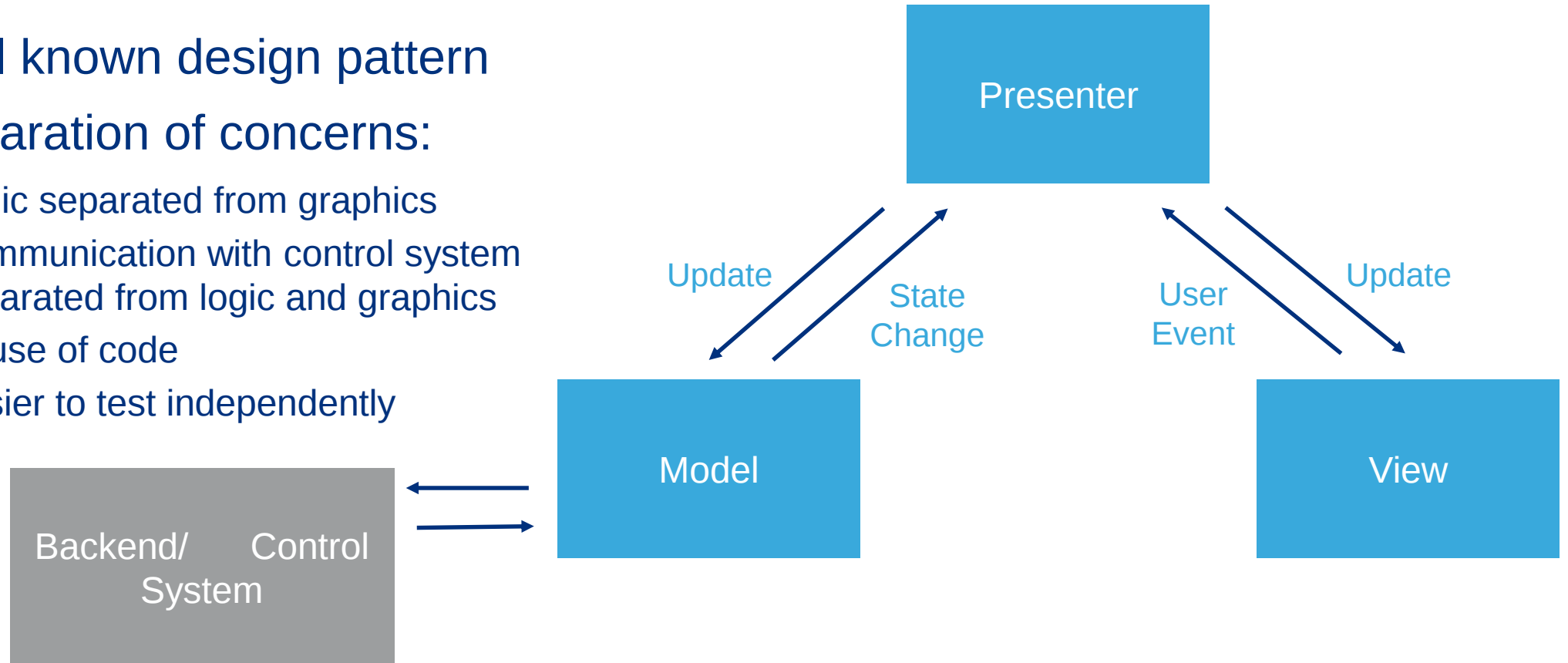
Advanced Graphical Objects

Draw lines, circles, custom shapes, and graphics, or apply scaling and 3D rotation to images at runtime with highly optimized and memory efficient algorithms.



Model-View-Presenter Software Architecture

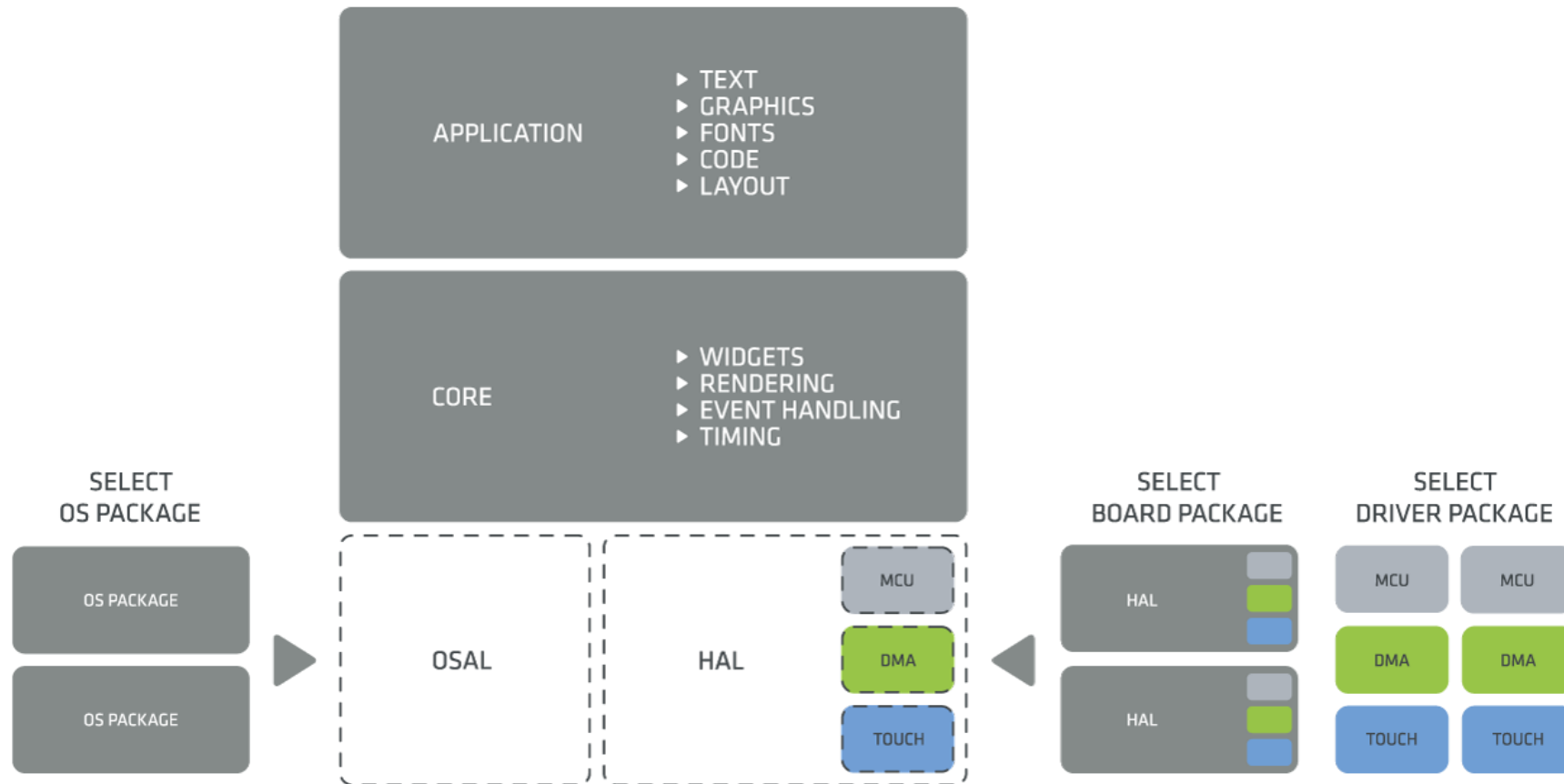
- Well known design pattern
- Separation of concerns:
 - Logic separated from graphics
 - Communication with control system separated from logic and graphics
 - Reuse of code
 - Easier to test independently



TouchGFX Technology

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Software Layers



TouchGFX例程&代码目录结构

touchgfx-4.7.0-eval

app

demo

- ▷ touchgfx_demo2014_240x320
- ▷ touchgfx_demo2014_480x272
- ▷ touchgfx_demo2015_480x272_8MB
- ▷ touchgfx_demo2015_640x480
- ▷ touchgfx_demo2015_800x480

example

- ▷ animation_example
- ▷ animation_texture_mapper_example
- ▷ arabic_text_example
- ▷ button_example
- ▷ canvas_widget_example
- ▷ clock_example
- ▷ custom_transition_example
- ▷ custom_widget_example
- ▷ display_orientation_example
- ▷ drag_example
- ▷ drag_example_4bit
- ▷ drag_example_24bit
- ▷ dynamic_bitmap_example
- ▷ keyboard_example
- ▷ list_layout_example

- ▷ modal_window_example
- ▷ monochrome_example
- ▷ move_fade_example
- ▷ pixel_data_example
- ▷ progress_indicator_example
- ▷ radio_button_example
- ▷ scale_zoom_example
- ▷ scrollable_container_example
- ▷ slide_menu_example
- ▷ slider_example
- ▷ text_example
- ▷ text_rotate_example
- ▷ texture_mapper_example
- ▷ transition_example

smartwatch_v1.1

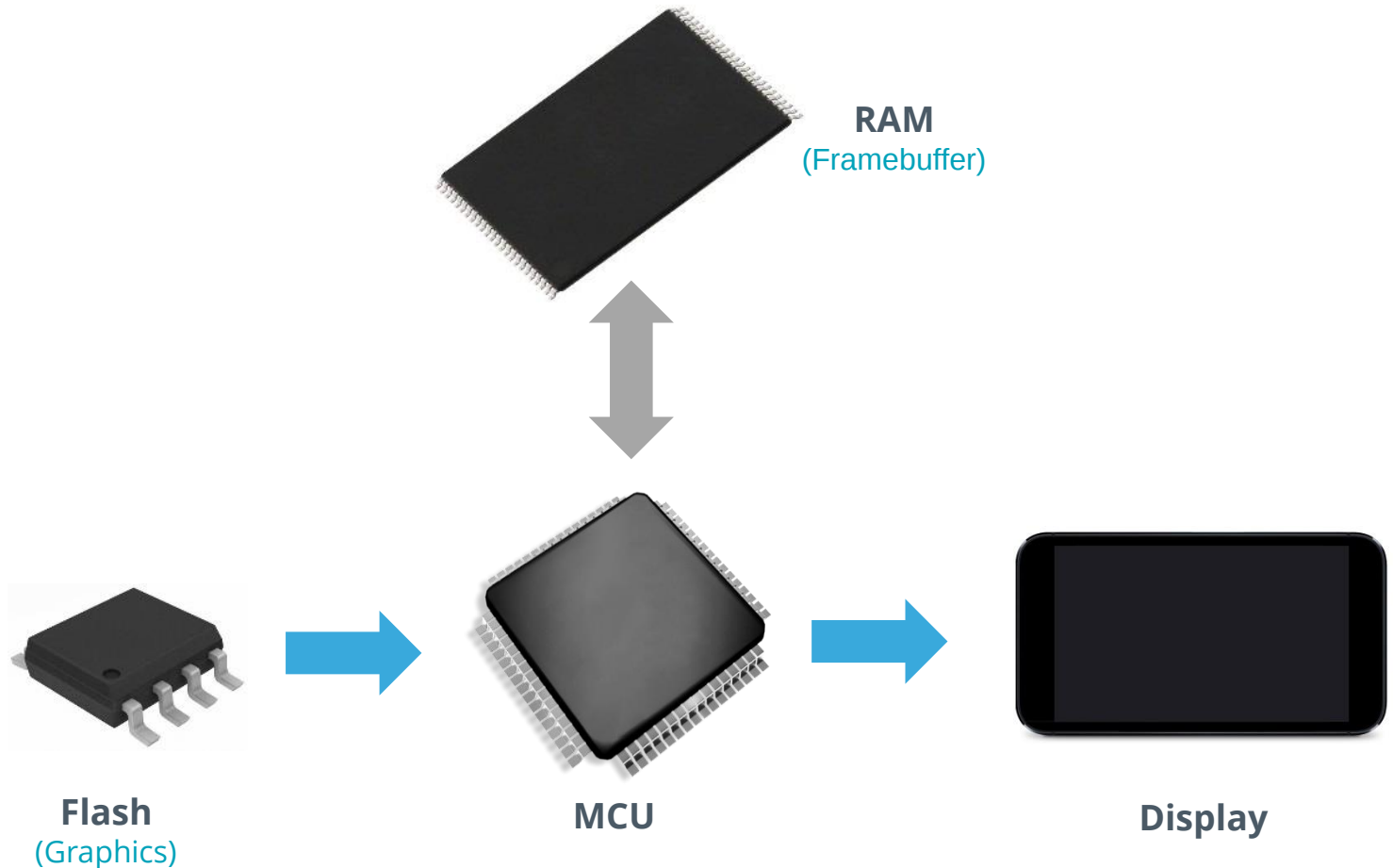
smartwatch

- ▷ assets
- ▷ build
- ▷ config
- ▷ generated
- ▷ gui
- ▷ platform
- ▷ simulator
 - gcc
 - msvs
- ▷ target
 - ST
 - STM32F769I-DISCO

Hardware Setup

Required Hardware

- Display
e.g. TFT-LCD WQVGA
- MCU
e.g. STM32F469
- Flash for Graphics
(internal or external)
- RAM for 1-3 framebuffers
(internal or external)



Targeted Platforms

Depending on exact parameters, such as display technology and resolutions, memory latency, and bandwidth, any Cortex-M based platform is a natural fit for TouchGFX.

Series	Core	Frequency	Graphic acceleration	Display IF	Resolutions
STM32F1	Cortex-M3	72 MHz	-	8080/6800 parallel IF	CGA/QVGA 320 x 200/320 x 240
STM32F2	Cortex-M3	120 MHz	-	8080/6800 parallel IF	CGA/QVGA 320 x 200
STM32L4	Cortex-M4	80 MHz	Chrom-ART	8080/6800 parallel IF	QVGA/WQVGA 320 x 240/480 x 272
STM32F4 Access and Foundation lines	Cortex-M4	100 to 180MHz	-	8080/6800 parallel IF	QVGA/WQVGA 320 x 240/480 x 272
STM32F4 advanced lines	Cortex-M4	180 MHz	Chrom-ART	8080/6800 parallel IF LCD TFT controller MIPI-DSI	Up to XGA
STM32F7	Cortex-M7	216 MHz	Chrom-ART HW Jpeg	8080/6800 parallel IF LCD TFT controller MIPI-DSI	Up to XGA 1024 x 768

TouchGFX works perfectly with integrated TFT controllers, internal or external frame buffers, and on systems that use LCD with integrated frame buffers and controllers.

TouchGFX Technology

Required Memory Resources

- Internal RAM for library:
 - 10-20 kB (framework and stack)
 - 1-15 kB (widgets)
- Internal/External RAM for framebuffer(s):

Memory usage depends on display resolution, color depth and the number of framebuffers (1,2 or 3).

Example: 480x272, 16 bit color, 2 framebuffers:
 $480 \times 272 \times 2 \text{ bytes} \times 2 = 520 \text{ kB}$.

If internal RAM, one framebuffer is sufficient.
- Internal/External Flash for library:
 - 20 kB (framework)
 - 1-100 kB (screen definitions, GUI logic)
- Internal/External Flash for image data:

Depends on the total size of the graphical elements, typically 1-20 MB.



TouchGFX Technology

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Targeted Platforms

- Operating System:

OS independent:

- Runs on any RTOS (uses just one task and two semaphores)
- Runs on Bare Metal (no OS)

- Display Types:

Support for various display types, e.g.:

- Parallel RGB
- MIPI-DSI
- 8080/SPI



STM32 Technology

GUI Advantages on STM32

- **JPEG Codec**
TouchGFX utilizes STM32 JPEG Codec, hereby offloading the CPU enabling easy creation of video sequences as an integrated part of a TouchGFX-based application.
- **Chrom-ART Accelerator™**
TouchGFX utilizes Chrom-ART to the max and offloads the CPU from repetitive graphic tasks.
 - Efficient 2D Image copy
 - Transparency
 - Picture format conversion



TouchGFX Supported ST Boards



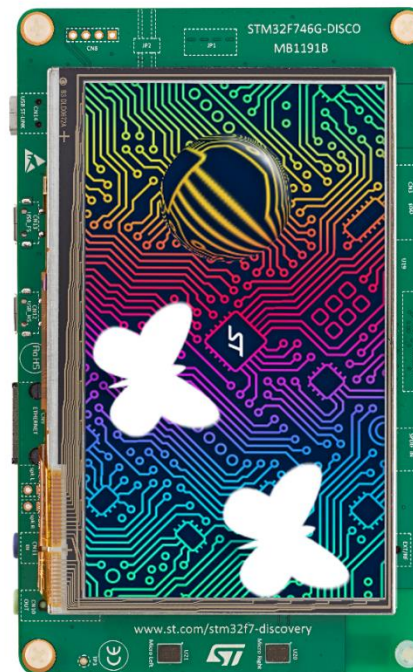
32F429IDISCOVERY

- STM32F429
- 320x240 QVGA LCD



32F469IDISCOVERY

- STM32F469
- 800x480 WVGA LCD



32F746GDISCOVERY

- STM32F746
- 480x272 WQVGA LCD



32F769IDISCOVERY

- STM32F769
- 800x480 WVGA LCD

TouchGFX Supported ST Boards



STM32429I-EVAL

- STM32F429
- 480x272 WQVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash



STM32439I-EVAL

- STM32F439
- 640x480 VGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash



STM32469I-EVAL

- STM32F469
- 800x480 WVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash



STM32756G-EVAL

- STM32F756
- 640x480 VGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash



STM32769G-EVAL

- STM32F769
- 800x480 WVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash

TouchGFX -3D缩放和旋转演示视频

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TouchGFX例程演示视频

Self-Service Solutions



Free Resources: Anytime, Anywhere

The TouchGFX Help Center is your gateway to TouchGFX knowledge and support.

Visit the thriving community to exchange solutions with peers and the TouchGFX team, get started easily with tutorials, or dig into the free articles and videos in the knowledge base.

Getting Started

Learn the basics of
TouchGFX



Knowledge Base

Discover helpful articles



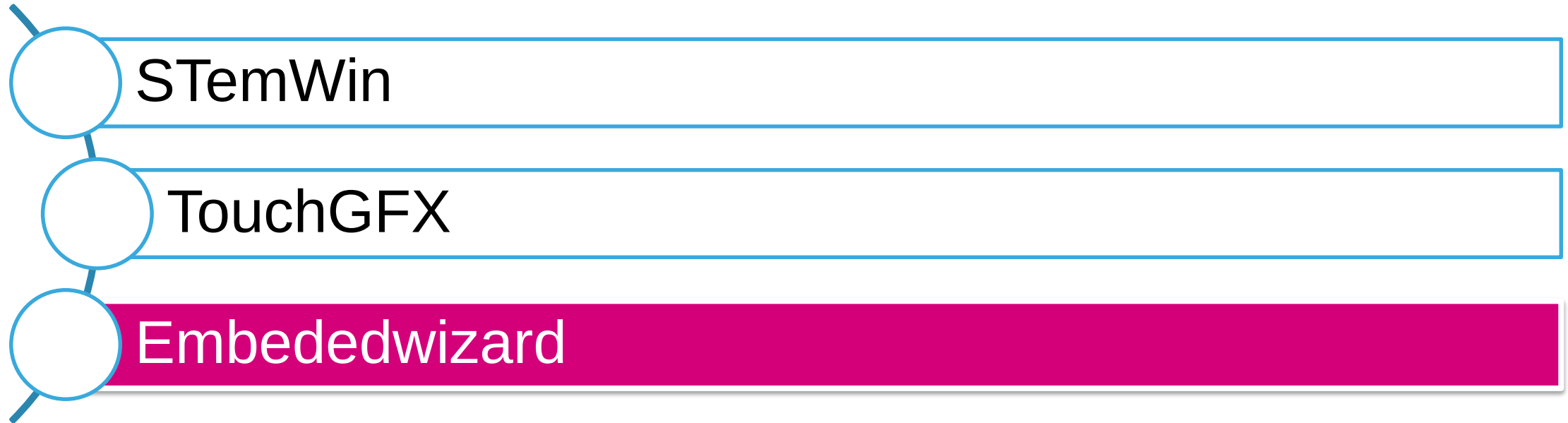
Community

Get help and help others



Click the boxes to visit webpages.

STM32 GUI 软件方案介绍

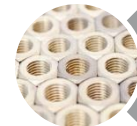
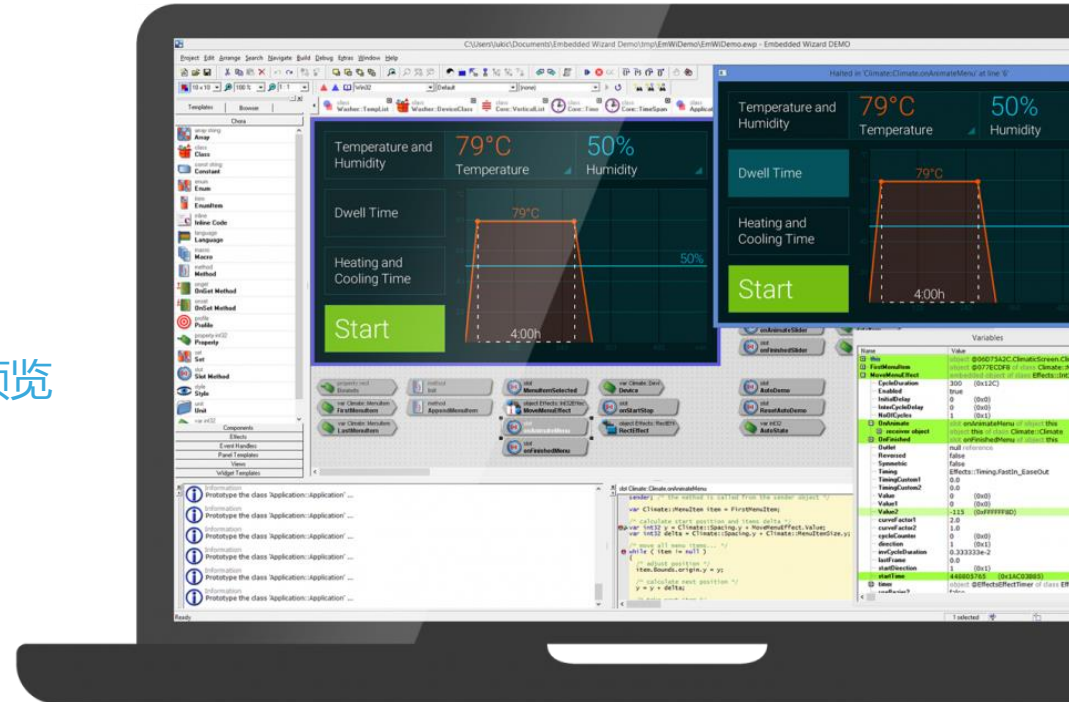


Embedded Wizard-GUI生成工具

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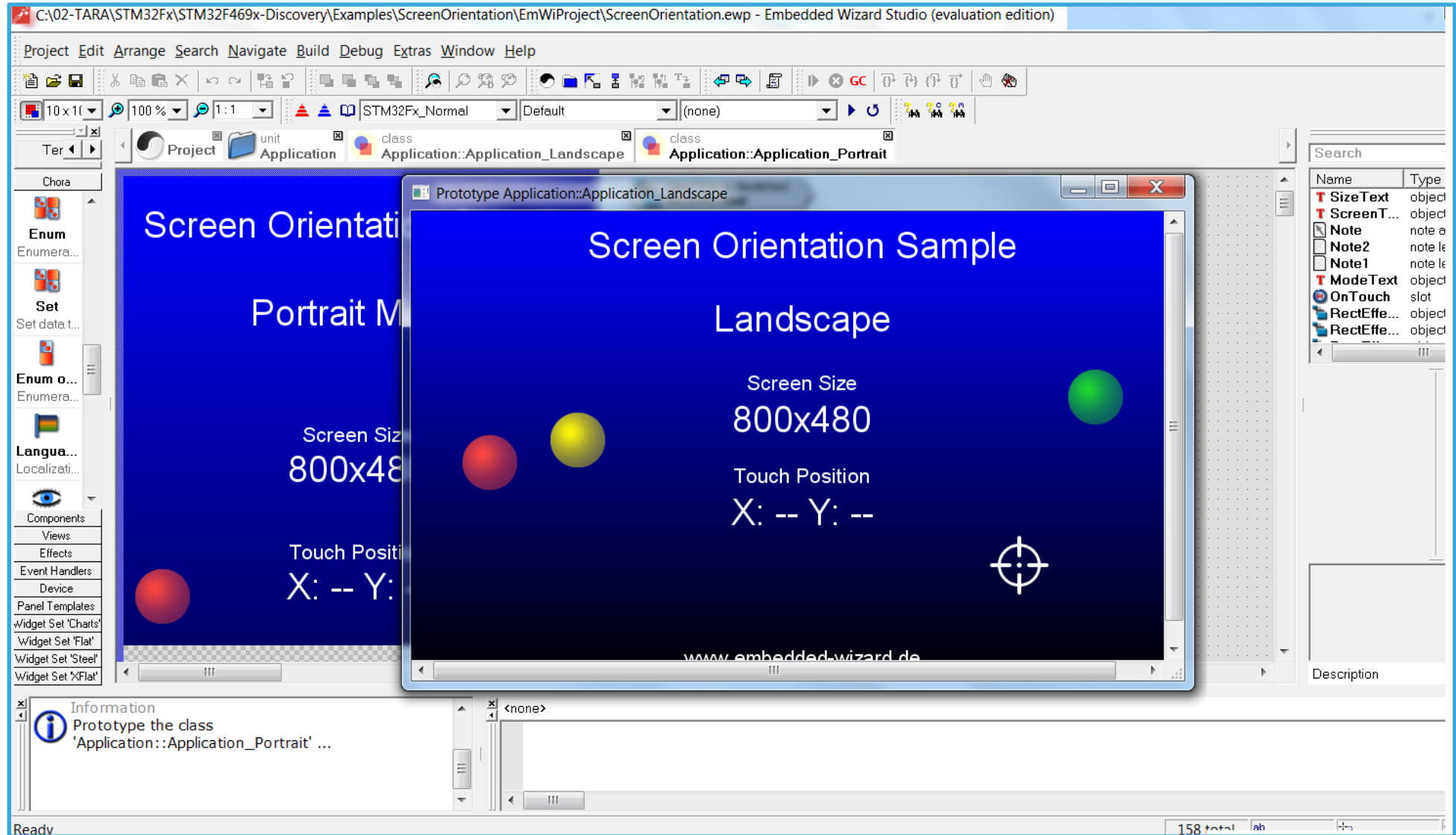


- 工具是关键：
 - 处理资源：字体、图片
 - 生成用户界面
 - 给开发者和客户关于UI效果的预览
 - 所见即所得(WYSIWYG)



UI 生成工具

Embedded Wizard-开发平台



The screenshot displays the Embedded Wizard IDE interface. The main workspace shows a GUI design titled "Embedded Wizard GUI Demos" with three buttons: "Climate Cabinet", "Washing Machine", and "Paper Cutter". The interface includes a menu bar (PROJECT, EDIT, ARRANGE, SEARCH, NAVIGATE, BUILD, DEBUG, EXTRAS, WINDOW, HELP), a toolbar, and a project browser on the left. The project browser shows a hierarchy: Project > unit Application > class Application:Application > class Application:HomeScreen. The right side features a property browser for the selected "Rectangle" object, showing properties like Name, Type, Order, AlphaBlended, Bounds, Color, ColorBL, ColorBR, ColorTL, and ColorTR. The bottom panel shows a code editor with the following code:

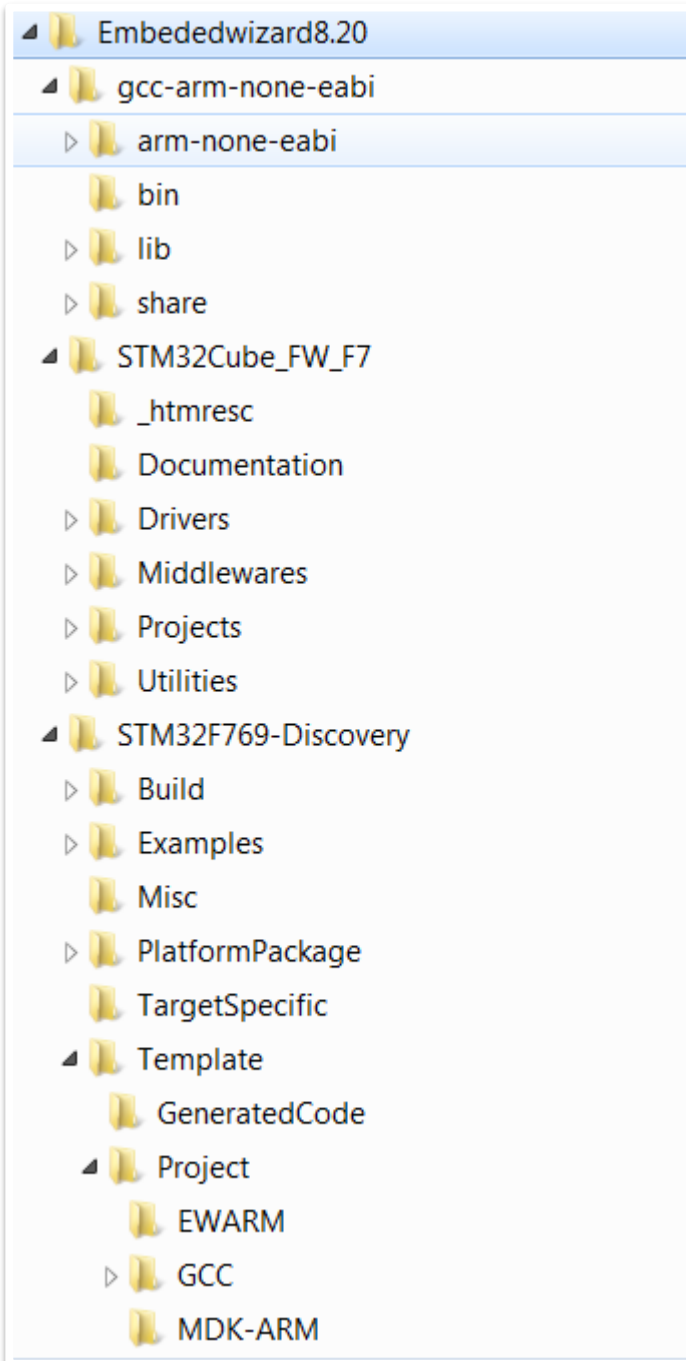
```

1 // As soon as the user has released the item - select it. Note, if
2 // the slide touch handler has taken over the touch events - ignore
3 // this operation.
4 if ( !SimpleTouchHandler.AutoDeflected )
5 {
6     // Determine the item at the touched position
7     var int32 item = HorizontalList.GetItemAtPosition( SimpleTouchHandler.CurrentPos );
8
9     // Select the item. If necessary scroll the list to make the item visible.
10    // Use a animation effect for this scrolling
11    HorizontalList.SelectedItem = item;
12
13    /* send a signal to the outer world to start the chosen demo */
14    switch ( item )
15    {
16        case 0: idlesignal OnClimateCabinet;
17        case 1: idlesignal OnWashingMachine;
18        case 2: idlesignal OnCuttingMachine;
19        case 3: idlesignal OnFitnessTracker;
20        case 4: idlesignal OnSmartThermostat;
    }
  
```

The status bar at the bottom indicates "Ready", "1 selected", "LINE 1", "COL 10", and "SIZE 800 x 480".

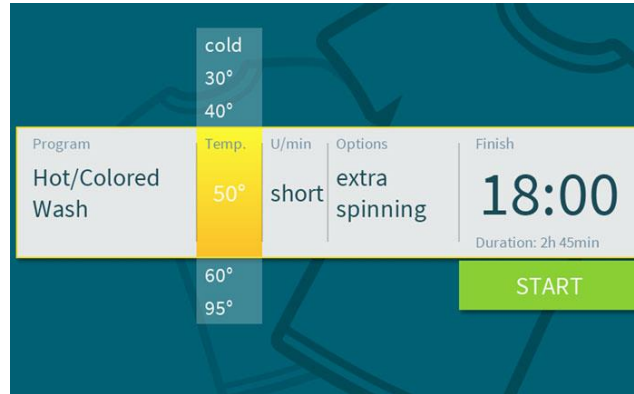
Embeddedwizard代码结构

46

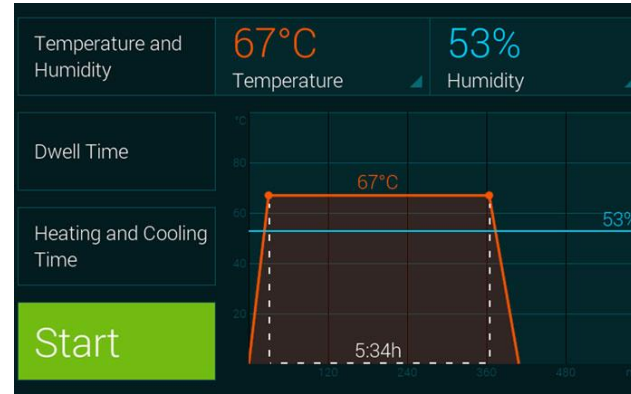


Sample GUIs

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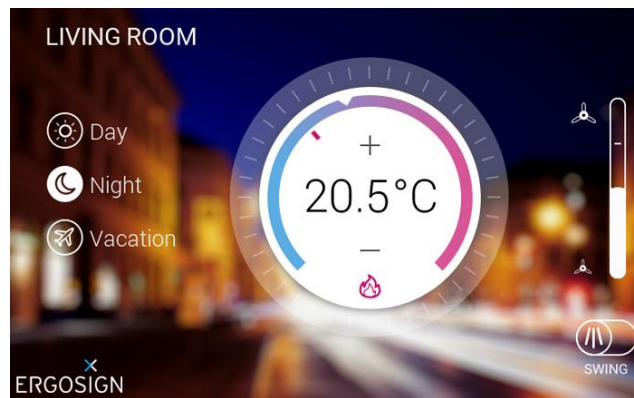
Washing Machine



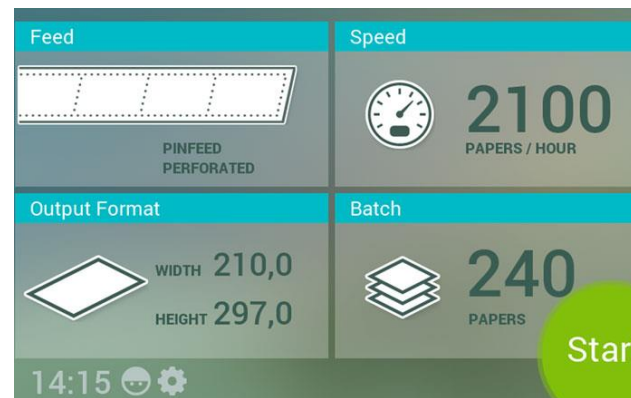
Climatic Cabinet



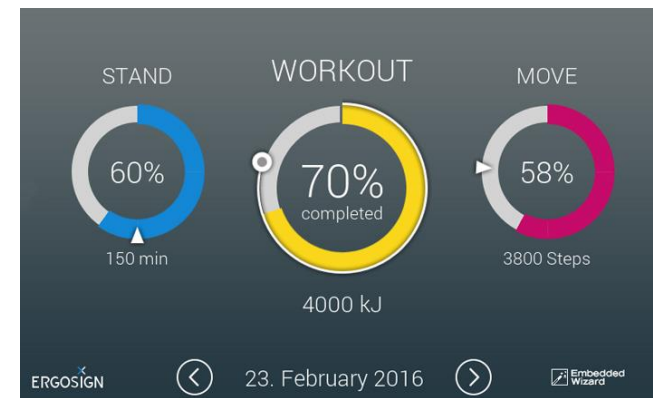
Various Gauges



Smart Thermostat



Paper Cutting Machine



Fitness Tracker

Embedded Wizard-特性简介

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- 跨平台

- 同一工程可运行于不同平台
 - 统一风格
- 基于跨平台语言Chora
 - 根据不同目标平台可以生成标准C或者JavaScript代码
- 以网页应用的形式生成用户界面
 - 客户可以通过浏览器访问网页即可跟UI互动

- IDE

- 友好强大的用户界面
- 可以在IDE中直接进行仿真

- 文档

- 自动生成帮助文件
 - 微软HTML帮助文件格式 (chm)
 - 便于移交项目和维护

Embedded Wizard-例程演示视频

Embedded Wizard-开发环境演示视频

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- Showcases and demos
www.embedded-wizard.de/demo
- Evaluation Edition
www.embedded-wizard.de/tryout
- Open Community Support Forum
ask.embedded-wizard.de
- Online Knowledge Base
doc.embedded-wizard.de
- YouTube Channel
www.youtube.com/c/EmbeddedWizard
- Follow us on Twitter
www.twitter.com/EmbeddedWizard



为支持STM32 GUI开发提供丰富的开发板

丰富的GUI开发板-STM32探索板

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32F429IDISCOVERY

- STM32F429
- 320x240 QVGA LCD
- 64 MBits SDRAM



32F469IDISCOVERY

- STM32F469
- 800x480 WVGA LCD
- 128 MBits SDRAM
- 128 Mbit QSPI Flash
- Arduino Uno



32F746GDISCOVERY

- STM32F746
- 480x272 WQVGA LCD
- 64 MBits SDRAM
- 128 Mbit QSPI Flash
- Arduino Uno

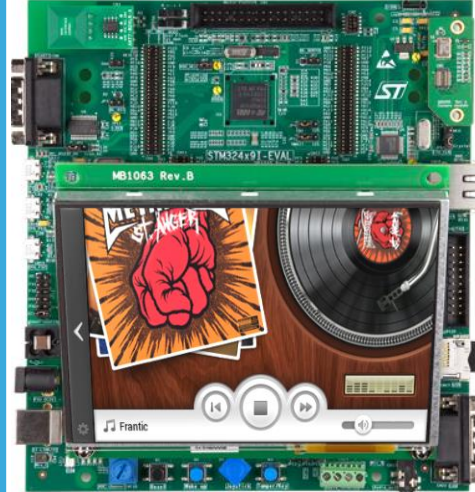
丰富的GUI开发板 – STM32评估板

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STM32429I-EVAL

- STM32F429
- **480x272 WQVGA LCD**
- 256 Mbits SDRAM
- 128 Mbits NOR Flash



STM32439I-EVAL

- STM32F439
- **640x 480 VGA LCD**
- 256 Mbits SDRAM
- 128 Mbits NOR Flash



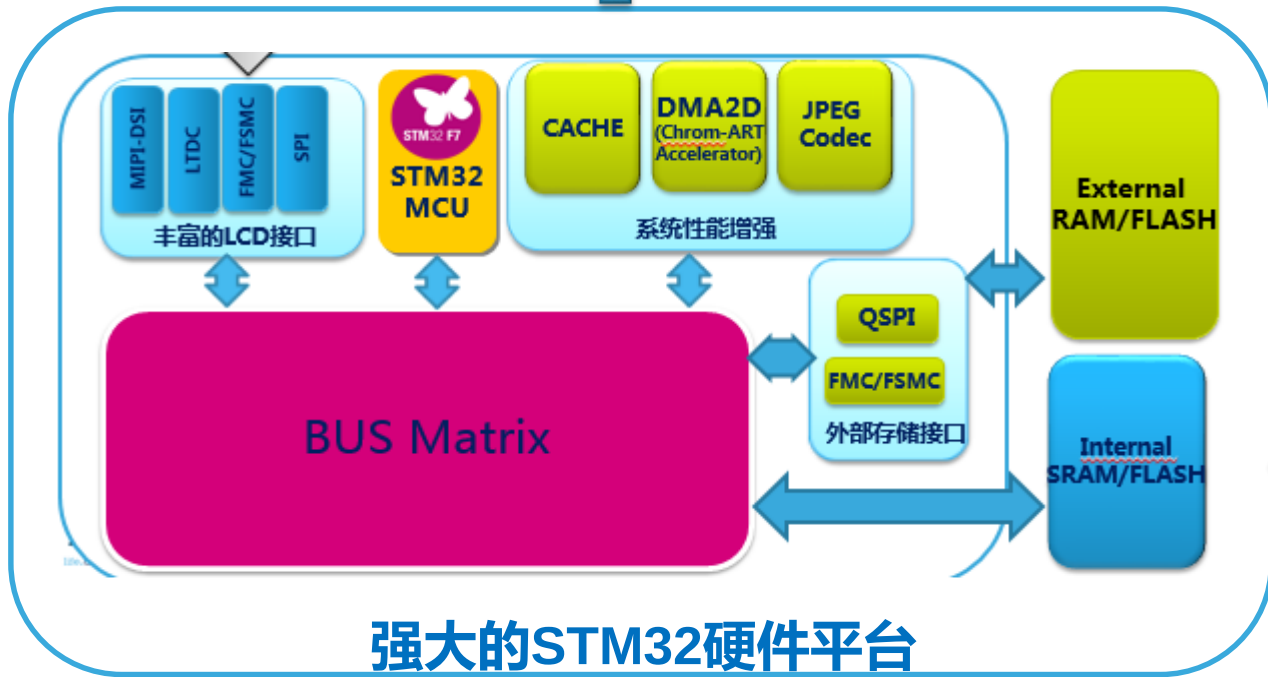
STM32469I-EVAL

- STM32F469
- **800x 480 WVGA LCD**
- 256 Mbits SDRAM
- 128 Mbits NOR Flash
- 512 Mbits QSPI Flash



STM32756G-EVAL

- STM32F756
- **640x 480 VGA LCD**
- 256 Mbits SDRAM
- 128 Mbits NOR Flash
- 512 Mbits QSPI Flash



总结





- STM32为用户界面应用开发提供了

- 强大的CPU处理能力及其丰富的外设接口
- 多个图形库供开发工程师选择
- 提供了丰富的用于评估和参考的GUI开发板

- 目前STM32用户界面设计方案已经广泛应用于:

- 便携或穿戴式消费电子产品，智能楼宇和工业控制器、智能家电、个人医疗设备、保健点医疗设备，车载电子等



Thanks !

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