Qt Graphics on Embedded

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Agenda

- Qt on Embedded Linux: building, docs

- Advancements in pure software rendering

- HW accelerated graphics, what's happening in eglfs

- What is (may be) on the table for the future
    - OpenGL optimizations, Path rendering, OpenVG, 2D acceleration, Emulator, Vulkan, CI, …

Embedded Development Boards

This is not it

60 fps
Lord of the Rings: The Two Towers
Much better
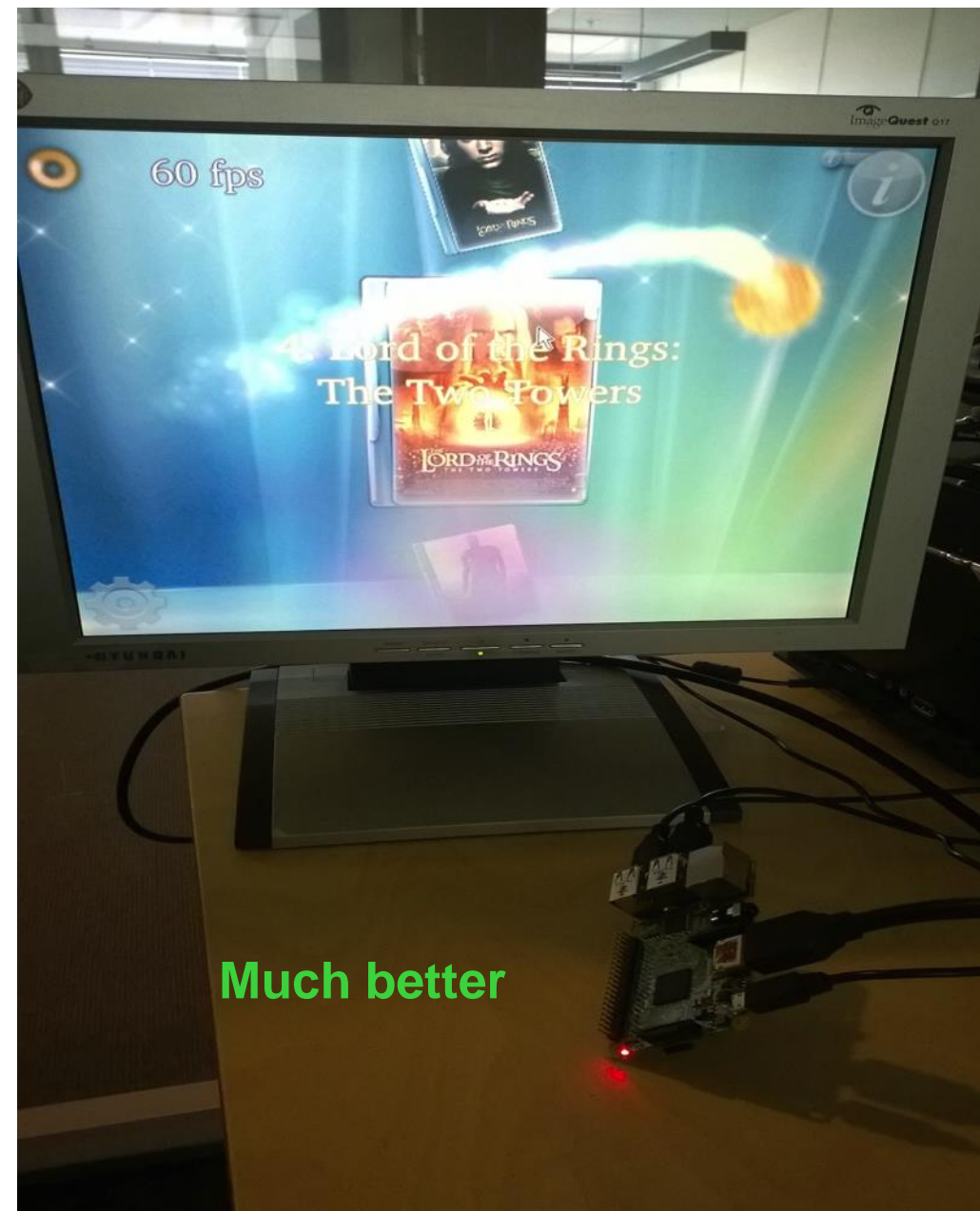
Windowing Systems in Device Creation

- Run a Qt app in fullscreen as the only GUI app

  - eglfs. EGL + OpenGL ES
  - linuxfb. Pure software
  - directfb. Some 2D acceleration

- Wayland (QtCompositor (on top of eglfs) or Weston + platform plugin from QtWayland)
  - EGL + OpenGL (ES)

- X11 – **not recommended**
  - xcb. EGL + OpenGL ES or GLX + OpenGL

Building Qt on Embedded

- Building

  - Cross-compilation
    - Manual
    - Yocto
      - http://blog.qt.io/blog/2016/07/01/aligning-with-the-yocto-project/
    - Others

  - On target

Documentation

- https://doc-snapshots.qt.io/qt5-dev/embedded-linux.html

  - Bit hard to find: Supported Platforms → Embedded Linux
  - Enhanced in every version.
  - Covers manual building and graphics + input stuff. No Yocto or other integration specifics.
  - Can feel convoluted due to covering multiple overlapping approaches plus some legacy stuff.

- http://doc.qt.io/QtForDeviceCreation/index.html

  - This is for the **commercial** additions, including the pre-built reference images and SDKs, Windows host support, some extra tooling, etc.
  - Under the hood it is still eglfs and co.

GPU-less rendering

- Qt 5.8 brings the Qt Quick 2D Renderer into Qt Quick core
  - LGPLv3 + commercial, like the rest of qtdeclarative

- Partial update support
  - Dirty rect tracking, no more fullscreen updates, great news for linuxfb

- Qt Quick now builds when OpenGL is disabled due to -no-opengl or autodetection

- Qt WebEngine is functional too on top

- i.MX7 and similar will love this

Speaking of license changes...

- Qt 5.7 brought some previously commercial components to open-source

  - GPLv3 + Commercial

    - Charts, Data Visualization, **Virtual Keyboard**
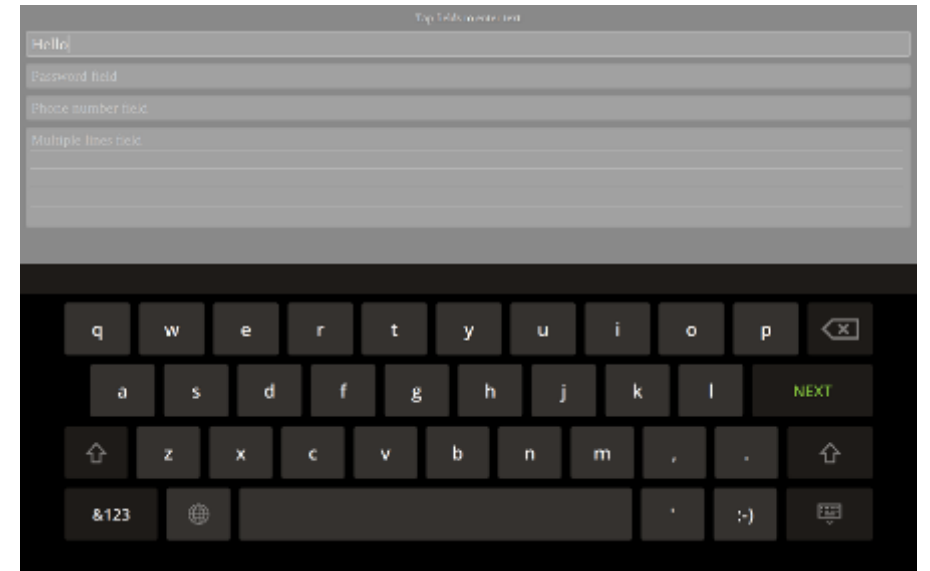
eglfs backends

- Development focus is on KMS/DRM

- Two variants: GBM (Mesa and others), EGLStream (NVIDIA)

- No big changes expected for others (Vivante fbdev, Mali fbdev, Broadcom dispmanx)

index : qt/qtbase.git

Qt Base (Core, Gui, Widgets, Network, ...)

summary   refs   log   tree   commit   diff   stats

path: root/src/plugins/platforms/eglfs/deviceintegration

Mode	Name
-rw-r--r--	deviceintegration.pro
d--------	eglfs_brcm
d--------	eglfs_kms
d--------	eglfs_kms_egldevice
d--------	eglfs_kms_support
d--------	eglfs_mali
d--------	eglfs_viv
d--------	eglfs_viv_wl
d--------	eglfs_x11

KMS/DRM improvements

- EGLDevice/EGLOutput/EGLStream support since Qt 5.6

- Qt 5.7 unifies a lot, code sharing between the two, basic multi-display for EGLStream as well.

- Adds NVIDIA DRIVE CX (AArch64) device spec.

- Qt 5.8 enhances multi-display for EGLStream:

    - should now be on-par with GBM
    - virtual desktop mouse cursor
   - touchscreen config (which screen does it belong to?)

KMS/DRM improvements

https://doc-snapshots.qt.io/qt5-dev/embedded-linux.html#display-output
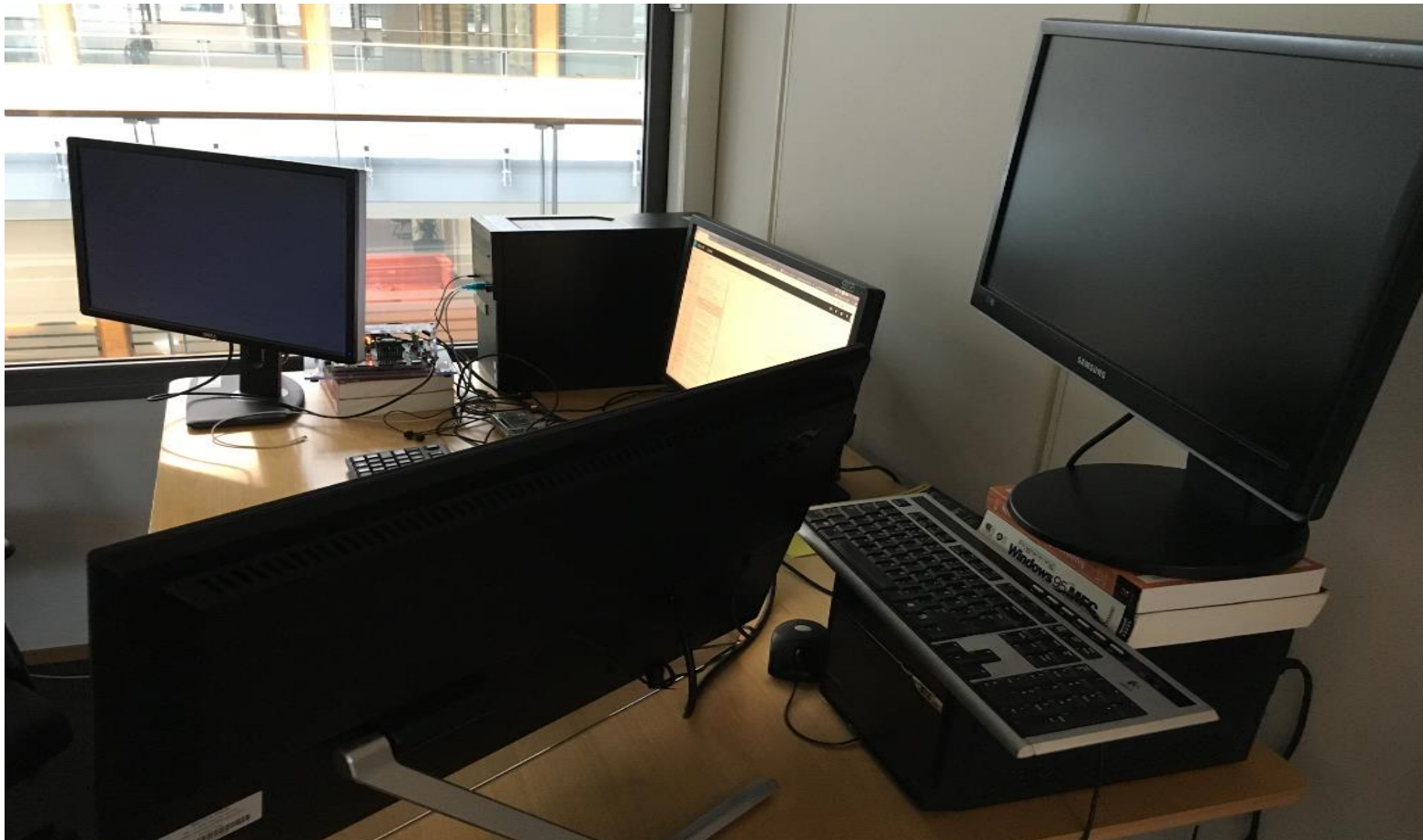
Future work plans. Qt 5.9 and beyond.

- OpenGL optimizations

  - Compressed textures

  - Pre-compiled shaders

  - Optimizations using ES 3.1 & 3.2

  - **Path rendering in Qt Quick**
    - Generic (triangulate, for OpenGL and D3D)
    - Software (something QPainter-based for the software backend)
    - GL_NV_path_rendering
      - vendor-specific, but available on desktop/mobile/embedded(!)
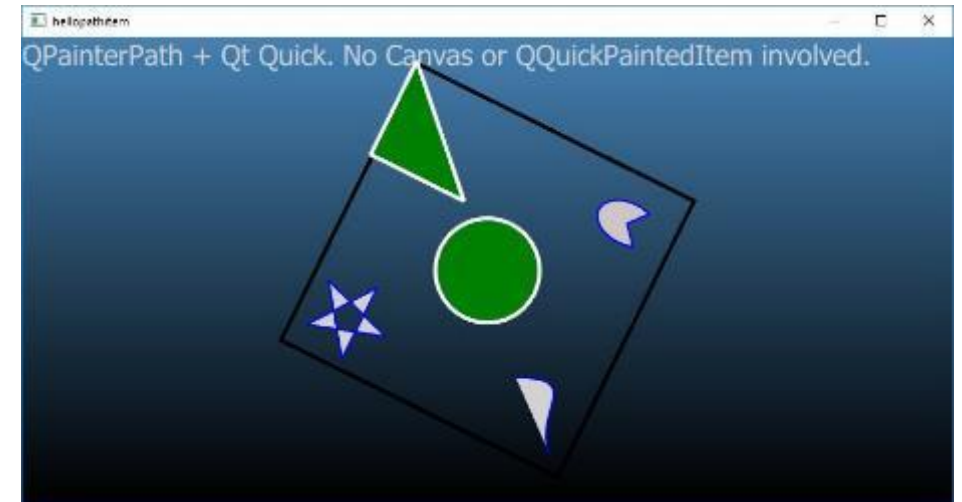
Future work plans. Qt 5.9 and beyond.

- 2D acceleration?

- Directfb platform plugin should still work but its future is somewhat unclear.

- OpenVG is kind of dead, but not fully. Prepare for potential surprises.

- Vendor-specific APIs (gal2d, g2d, …)
  - Perhaps.

Future work plans. Qt 5.9 and beyond.

- Everyone's favorite topic: Vulkan!

- Without wide-spread embedded adoption there's little motivation.

- Qt Quick gains an experimental D3D12 backend in Qt 5.8.

  - New low-level APIs present a lot of work and little reward for typical UIs.

  - There is a lot of room for research. (threads, threads, threads. but can be difficult to fit into an existing architecture.)

                                                    (Jetson/L4T does not count)

- So far encountered one *device creation oriented* embedded board with Vulkan support, but without a WSI. Some success with using GL_NV_draw_vulkan_image to integrate Vulkan rendering into Qt Quick apps.

Future work plans. Qt 5.9 and beyond.

- There are some ideas for basic enablers for setting up WSI and rendering. Maybe Qt 5.9, but likely later.

  - To enable cross-platform Vulkan into a QWindow or a window embedded into widgets.

- In the meantime: https://github.com/alpqr/qtvulkan

- Qt Quick backend for Vulkan: do not hold your breath. However, some people expressed interest in working on this, so who knows.

Future work plans. Qt 5.9 and beyond.

- Continous Integration?

- The Qt Project CI system has one configuration to do 32-bit ARM cross-compilation.
  - Only compilation, no tests run.
  - Does not check if the results are functional, e.g. graphics-wise.

- 64-bit ARM Linux (since Qt 5.7) was challenging. Some manual testing only. Then got regressions and JIT problems discovered along the way.

- Some work on-going to put Jetson TX1s into the test farm.
  - Lancelot already running (non-blocking graphics testing, Qt built on device, X11, not really device creation style but at least 64-bit ARM)

Future work plans. Qt 5.9 and beyond.

- Emulator?

- Part of Qt for Device Creation and the Qt Automotive Suite.

- Based on VirtualBox and streaming EGL/GLES commands between the VM running a Yocto-generated Linux image and the host.

- Plans for bringing multi-display and multi-process (Wayland) simulation capabilities to it.
  - New eglfs_emu backend.
  - QtWayland integrations for GL streaming.

Thank You!

https://github.com/alpqr/qtcon2016