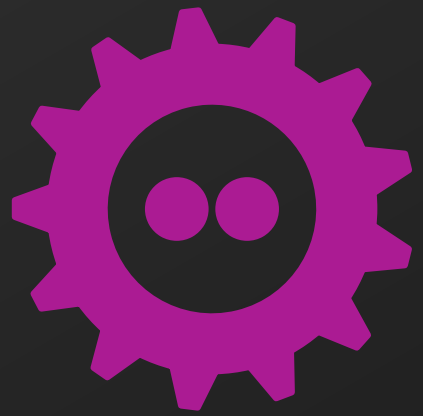


The year of the virtual Linux Desktop

Lubosz Sarnecki

02 / 02 / 2020

FOSDEM'20

COLLABORA

Lubosz Sarnecki

<lubosz.sarnecki@collabora.com>

https://twitter.com/spulaniraba

Very brief XR crash course

Reality–virtuality continuum

Milgram, 1994

Types of interreality systems

VR Virtual Reality

AV Augmented Virtuality

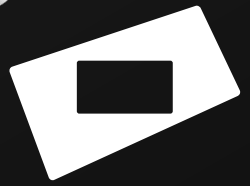
AR Augmented Reality

MR Mixed Reality

XR X Reality / Cross Reality

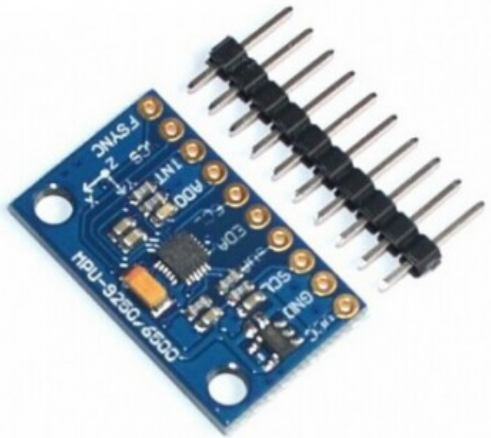
Types of XR devices

- Phone adapter
- PC tethered
- Stand alone / Belt



IMU Tracking

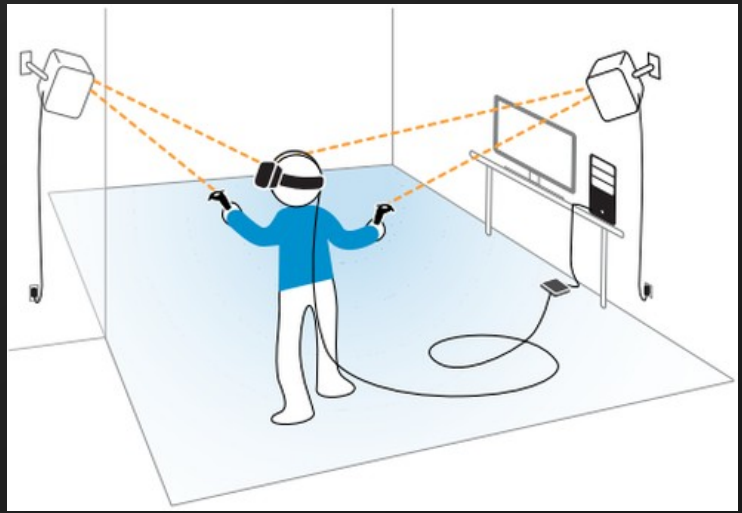
- Intertial Measurement Unit
- 3 Degrees of Freedom (DoF)
- Gyroscrope, Accelerometer sometimes Magnetometer
- High Frequency

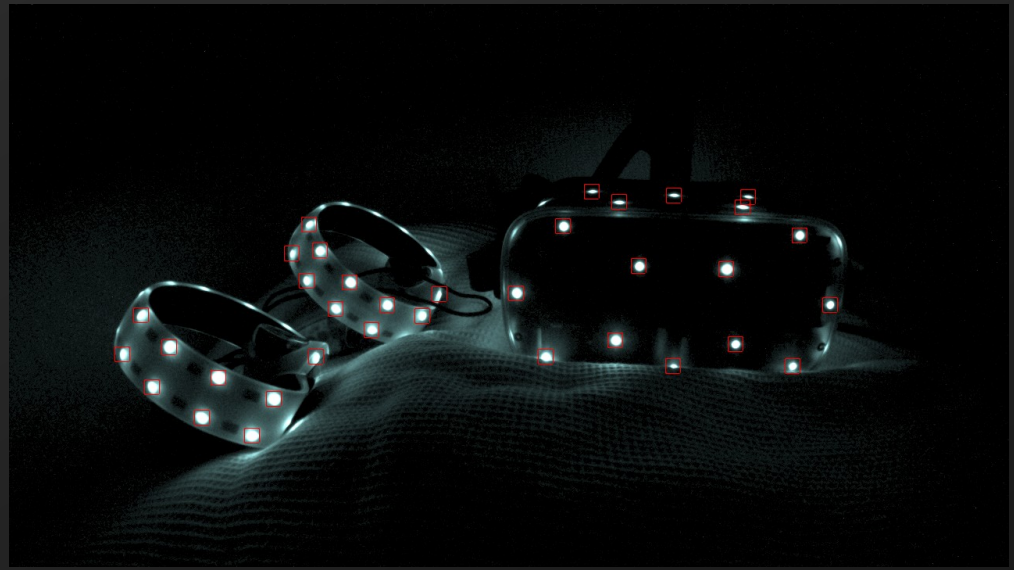


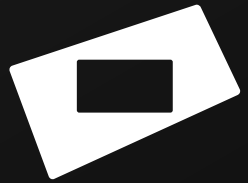
TDK MPU-9250

External Optical Tracking

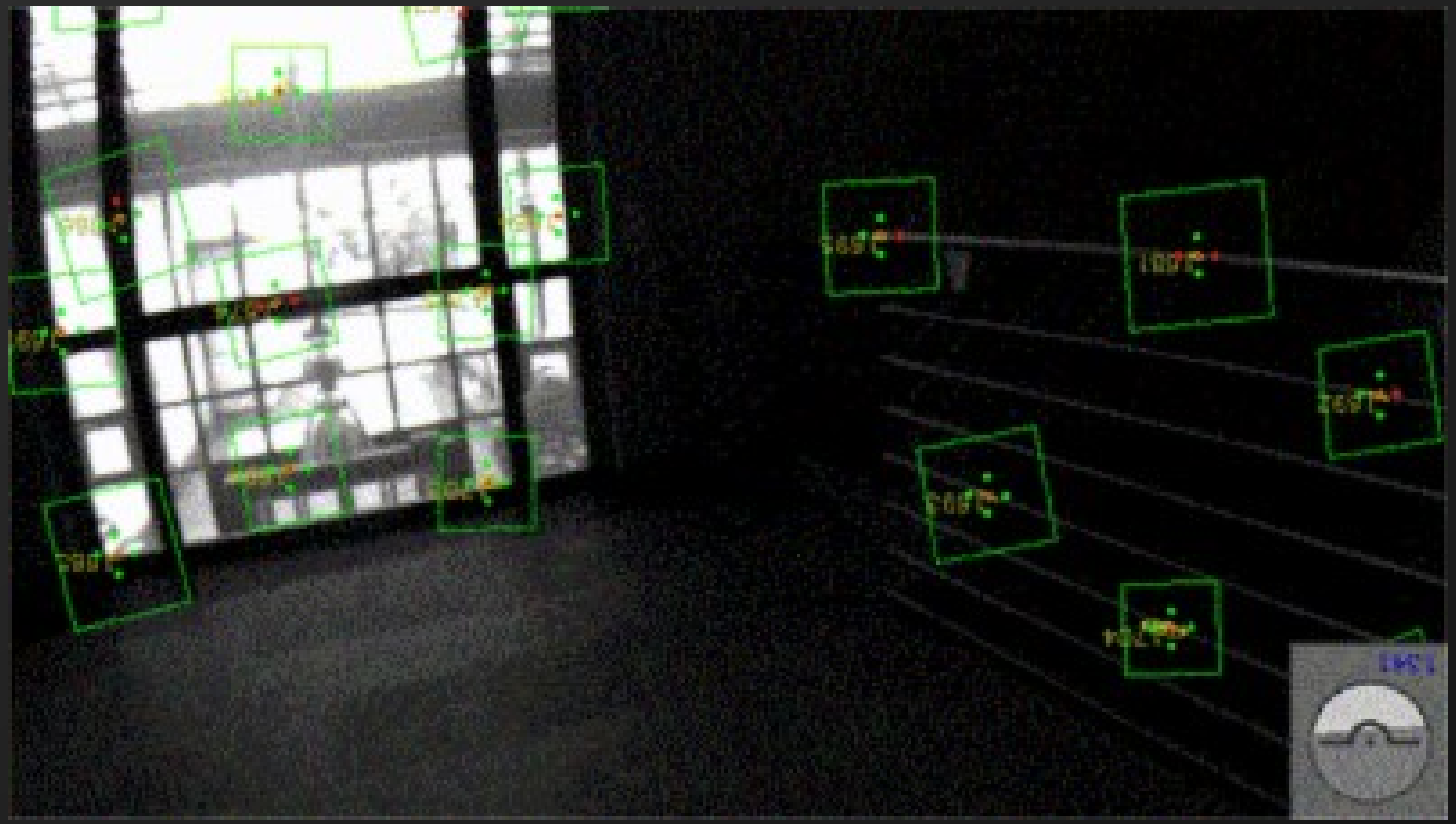
- 6 DoF





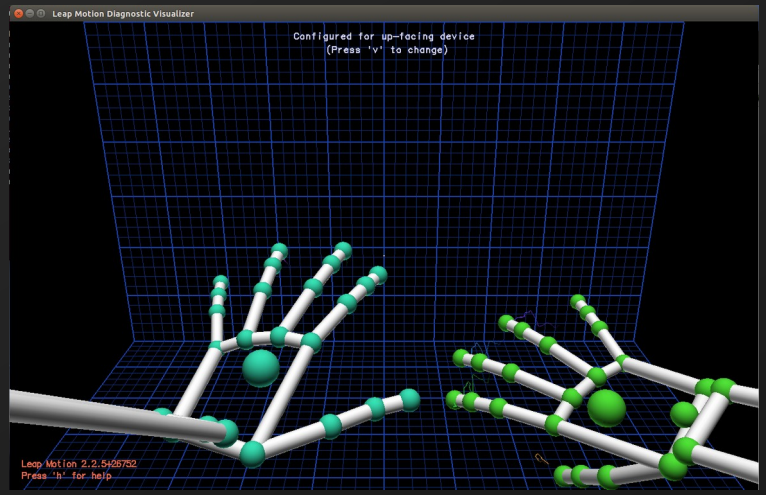


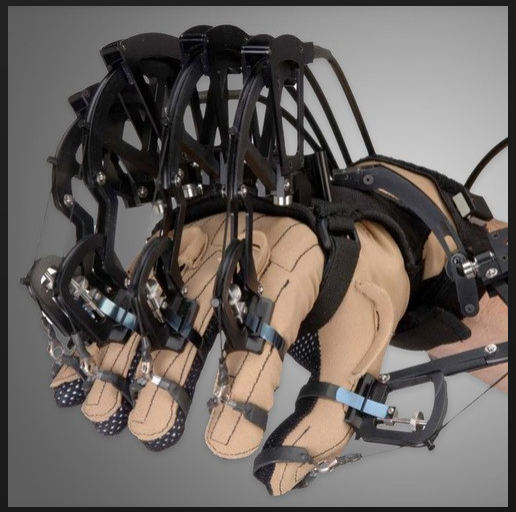
SLAM



VR Input

Hand Tracking





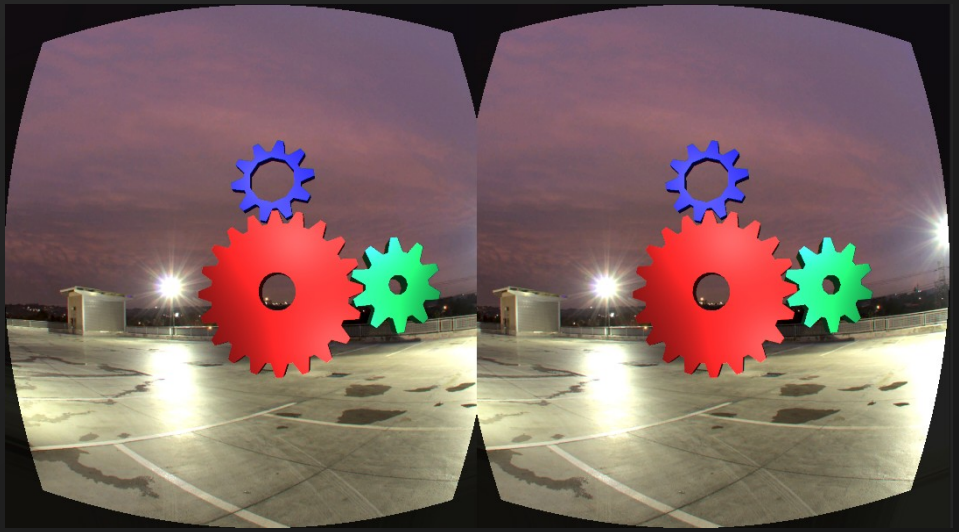
FOSS XR

Direct Mode

- Desktop not extended to HMD
- Native resolution and refresh rate
- DRM leasing with non-desktop displays in Xorg
- `X11 Vulkan extension: VK_EXT_acquire_xlib_display`

xrgears

- Vulkan VR demo using OpenHMD
- XCB and Wayland extended mode
- Reference implementation of VK_EXT_acquire_xlib_display
- Basis for Monado compositor
- Ported to OpenXR application



https://gitlab.freedesktop.org/monado/demos/xrgears

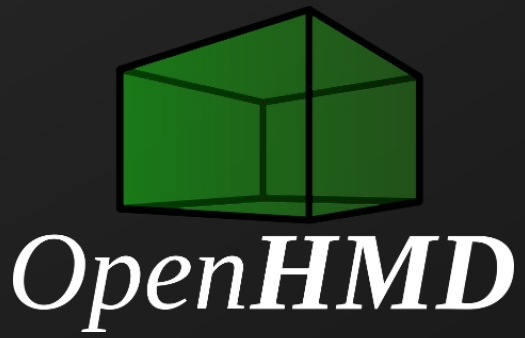
Direct Mode on Wayland

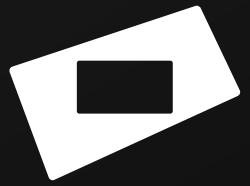
- Vulkan extension: VK_EXT_acquire_wl_display
- Protocol: drm_lease_unstable_v1
- Support for Xwayland
- Branch for Monado

https://drewdevault.com/2019/08/09/DRM-leasing-and-VR-for-Wayland.html

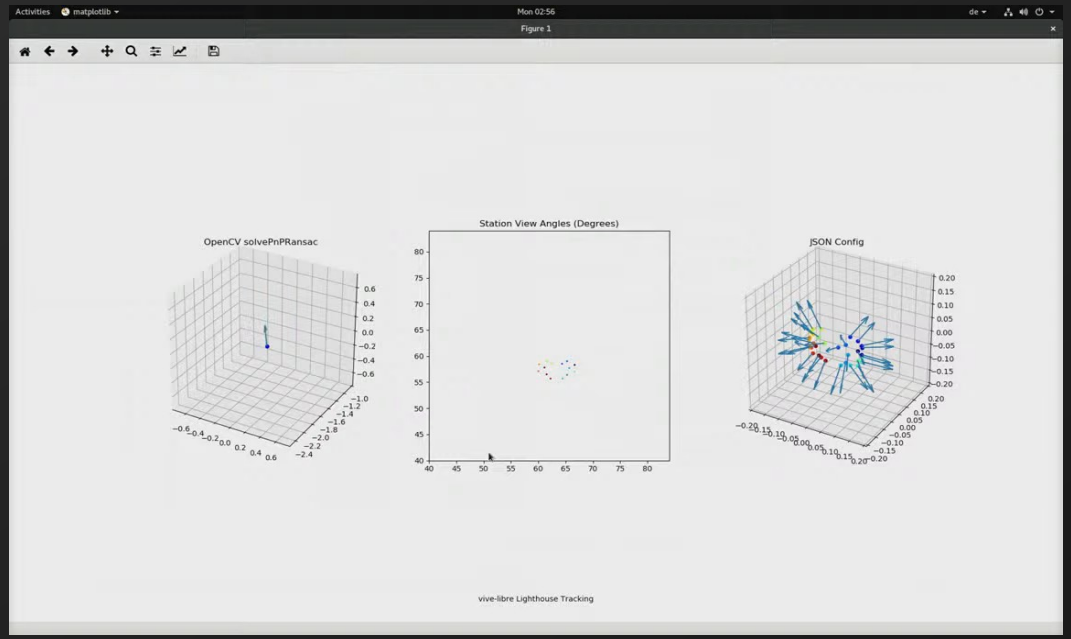
Notable FOSS Tracking Projects

- OpenHMD
- libsurvive
- Maplab (SLAM)
- Others: Lighthouse Redox, PSMoveService, OpenPSVR, OSVR, OpenTrack, openvslam





Vive Libre



Collabora R&D (Lubosz Sarnecki, Pekka Paalanen), 2017

libsurvive

- FOSS Lighthouse driver
- Base on Vive Libre
- Multiple Posers
- Controller support
- Branch for Monado

https://github.com/cnlohr/libsurvive

FOSS SLAM Implementations

GPLv2
https://openslam.org/cas-rnt.html

LGPLv2
https://openslam.org/iSAM.html

LGPLv3
https://openslam.org/robotvision.html
https://openslam.org/ssa2d.html

GPLv3
https://github.com/raulmur/ORB_SLAM
https://github.com/raulmur/ORB_SLAM2
https://sourceforge.net/projects/slam6d/
https://openslam.org/copslam.html
https://openslam.org/ekfmonoslam.html
https://openslam.org/flirtlib.html
https://openslam.org/hog-man.html
https://openslam.org/openratslam.html
https://openslam.org/orbslam.html
https://openslam.org/openseqslam.html
https://github.com/felixendres/rgbdslam_v2
https://openslam.org/robomap.html
https://openslam.org/slam6d.html
https://openslam.org/tjtf.html
https://openslam.org/vertigo.html
https://openslam.org/evg-thin.html
https://openslam.org/kld-sampling.html
https://github.com/tum-vision/lsd_slam
https://github.com/HKUST-Aerial-Robotics/VINS-Mobile

New BSD License
https://github.com/MRPT/mrpt

BSD
https://github.com/RainerKuemmerle/g2o
https://openslam.org/gmapping.html
https://github.com/agpratik/max-mixture
https://openslam.org/MTK.html
https://github.com/laboshinl/loam_velodyne
http://introlab.github.io/rtabmap/
https://github.com/evil0sheep/pcl-slam

Apache 2
https://github.com/googlecartographer/cartographer

MIT
https://openslam.org/tinyslam.html
http://trac.laas.fr/git/rtslam-jafar

Imperial College London / ElasticFusion License
https://github.com/martinruenz/co-fusion
https://github.com/mp3guy/ElasticFusion
https://github.com/mp3guy/Kintinuous
https://github.com/victorprad/InfiniTAM

Creative Commons (Attribution-NonCommercial-ShareAlike
https://openslam.org/falkolib.html
https://github.com/niessner/BundleFusion
https://openslam.org/linearslam.html
https://openslam.org/ParallaxBA.html
https://openslam.org/toro.html
https://openslam.org/treemap.html
https://openslam.org/ufastslam.html
https://openslam.org/people2d.html

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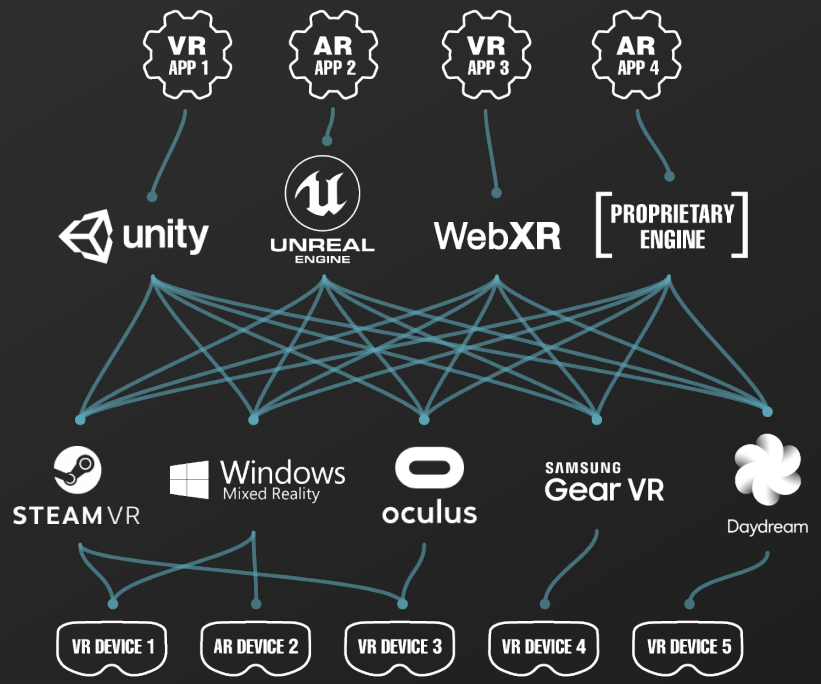
https://openslam.org/cekfslam.html
https://openslam.org/dpslam.html
https://openslam.org/gridslam.html
https://openslam.org/bailey-slam.html
https://openslam.org/slom.html

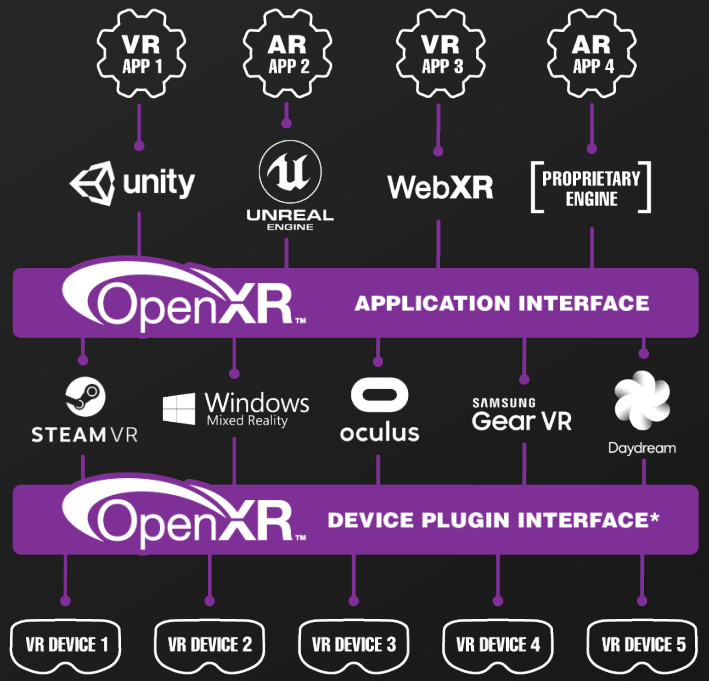
https://openslam.org

OpenXR™



Before OpenXR

XR Market Fragmentation



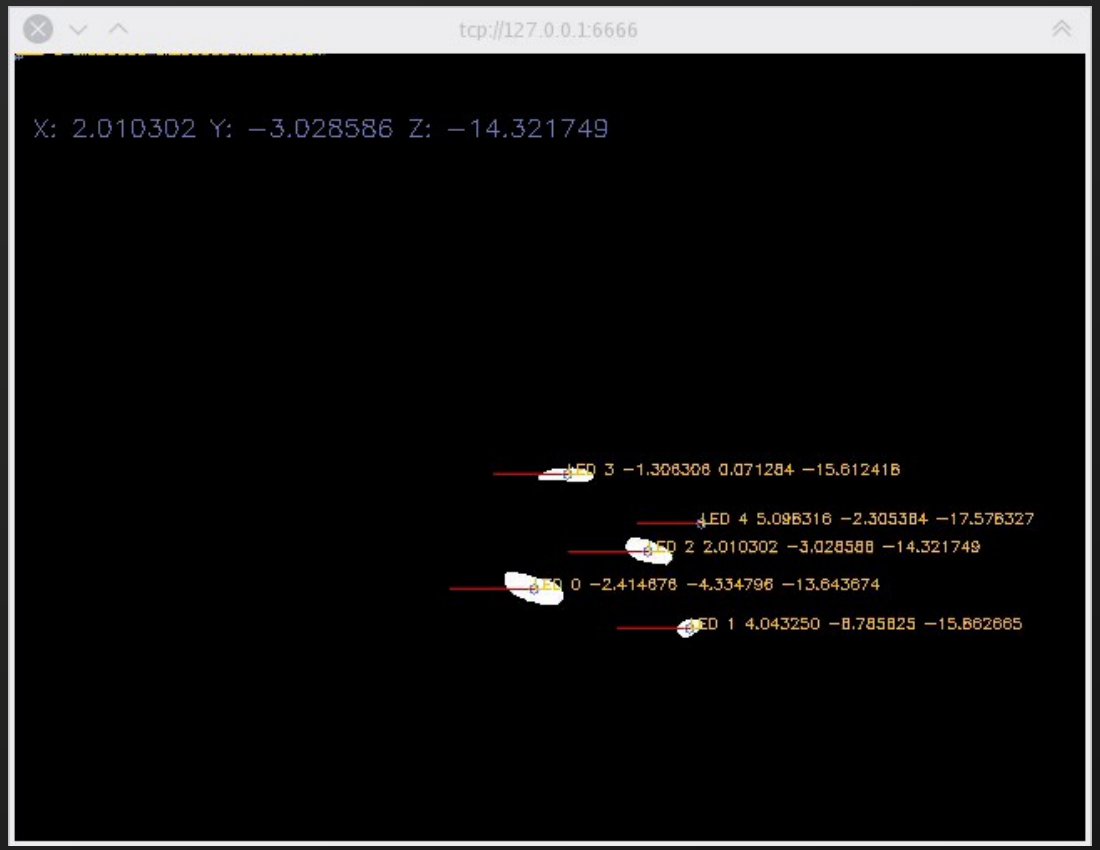
After OpenXR

Wide interoperability of XR apps and devices

Monado

- FOSS OpenXR implementation
- Mesa of OpenXR
- Uses OpenHMD, libsurvive and internal device drivers
- Vulkan XR compositor with direct mode
- 6 DOF tracking: WIP for Vive and PSVR

PSVR Tracking Prototype



The desktop in VR

xrdesktop

xrdesktop

VALVE®

Demo

Actions and Bindings

- XR APIs use Action definitions
- Actions can be bound to physical controllers
- Common types: Analog, Digital, Pose
- Similar in OpenXR and OpenVR

```
   "actions":[
      {
         "name":"/actions/wm/in/grab_window",
         "type":"boolean"
      },
      {
         "name":"/actions/wm/in/reset_orientation",
         "type":"boolean"
      },
      {
         "name":"/actions/wm/in/show_keyboard",
         "type":"boolean"
      },
      {
         "name":"/actions/wm/in/push_pull",
         "type": "vector2"
      },
      {
         "name":"/actions/wm/in/push_pull_scale",
         "type": "vector2"
      },
```

Push / Pull
Scale
Open Keyboard click
Push / Pull
Toggle Menu B
press Grab Window
click Reset Orientation
press UI Click
3D
Scroll
Right Click B
Left Click A
2D

Toggle Menu

Push / Pull

Scale

press Grab Window

click Reset Orientation

press UI Click

squeeze Open Keyboard

3D

Right Click

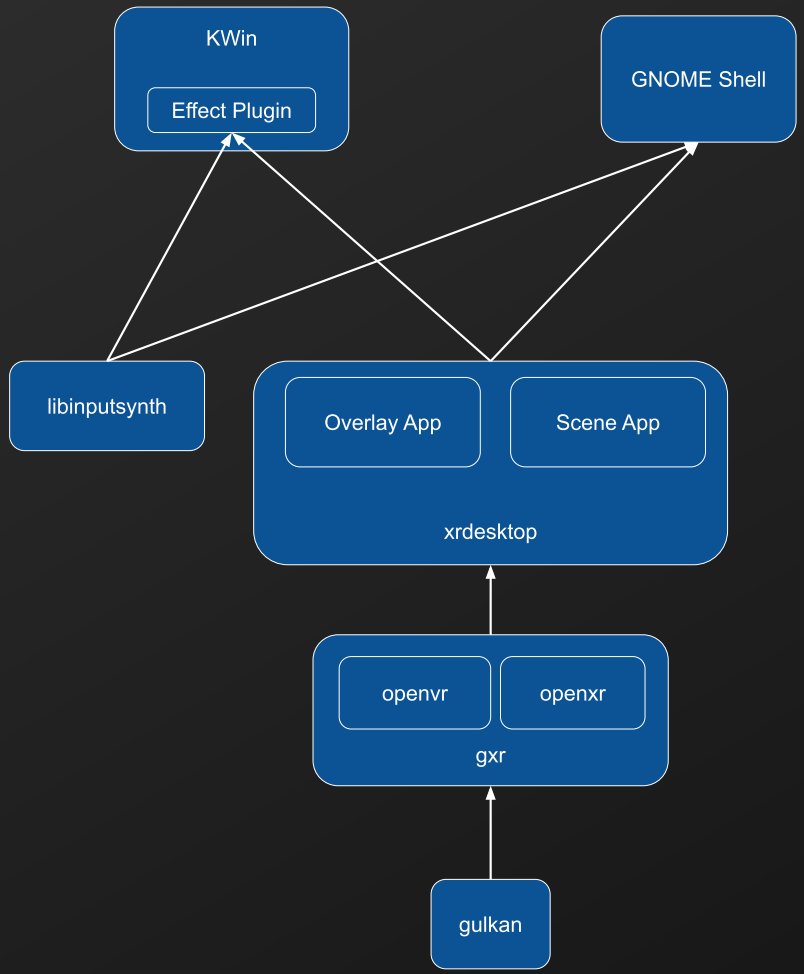
Scroll

Left Click click

2D

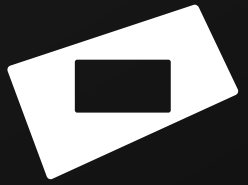
xrdesktop under the hood

Our Stack


KWin
Effect Plugin
GNOME Shell
libinputsynth
Overlay App
Scene App
xrdesktop
openvr
openxr
gxr
gulkan

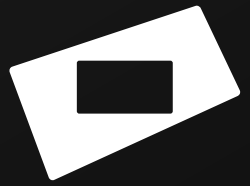
Synthesizing input

- Create mouse and keyboard events
- Multiple backends like xdotool
- X11 needs visible window
- Clutter backend for GNOME on Wayland



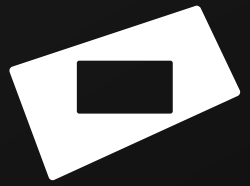
Sharing window buffers

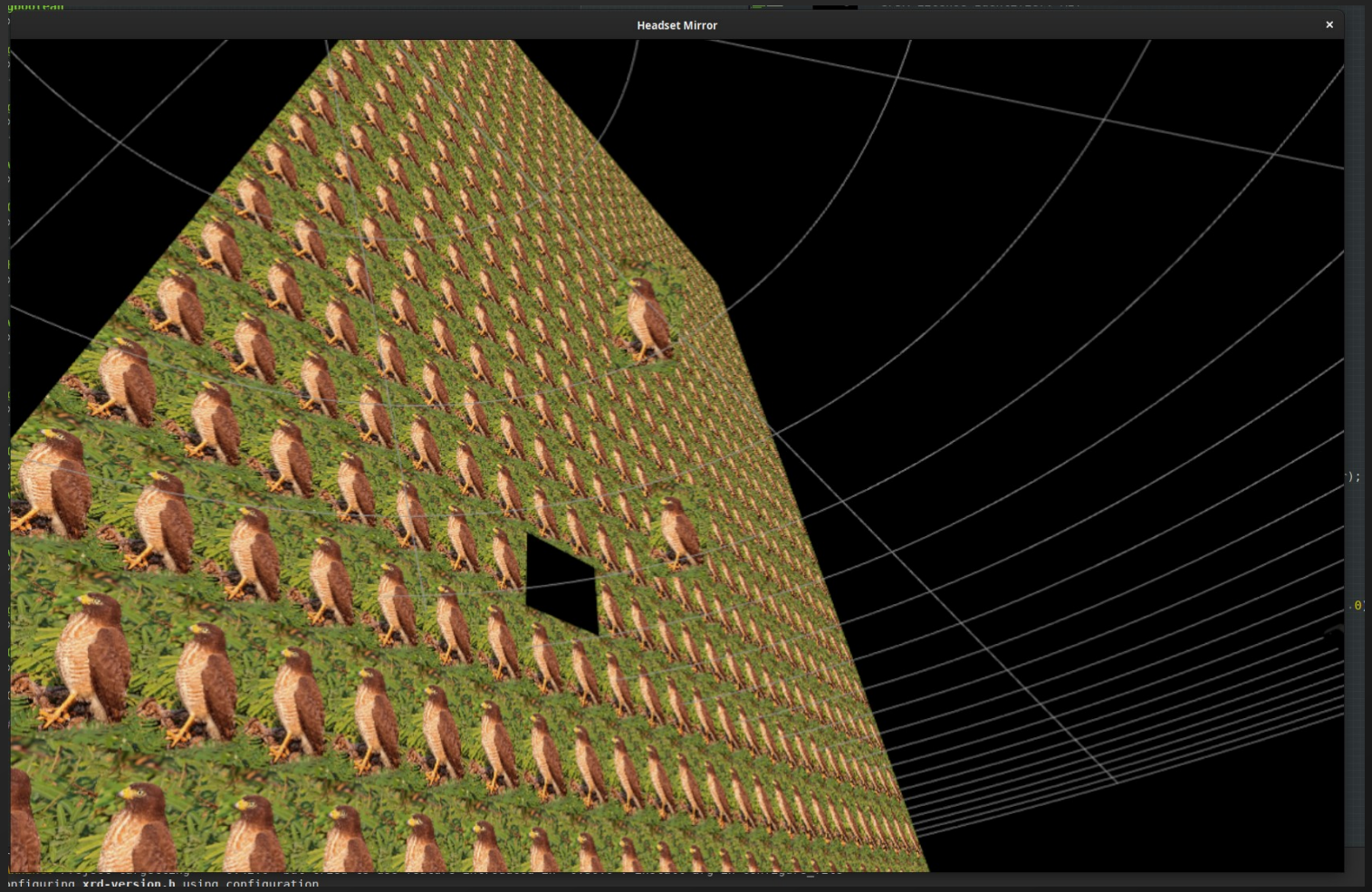
- Zero copy
- GL / Vulkan interop
- Requires `VK_KHR_external_memory` and `GL_EXT_memory_object`
- GL extension currently only available on AMD and NVIDIA



Overlays

- Use desktop windows over VR application
- Overlays in OpenVR
- Rectangular XrCompositionLayer in OpenXR
- Full scene application

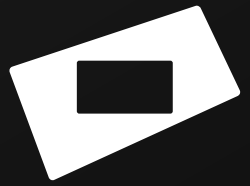




xrdesktop Scene renderer

xrdesktop 0.14 release

- Shortly after FOSDEM
- Support for OpenXR
- Many rendering and API improvements
- Biggest release yet ~364 commits in core repos.



Where to get it

- Arch Linux User Repository
  https://aur.archlinux.org/packages/xrdesktop-git
- Ubuntu PPA

  https://launchpad.net/~xrdesktop/+archive/ubuntu/xrdesktop/+packages
- Build from source
  https://gitlab.freedesktop.org/xrdesktop/xrdesktop/-/wikis/Installation-from-source

Roadmap

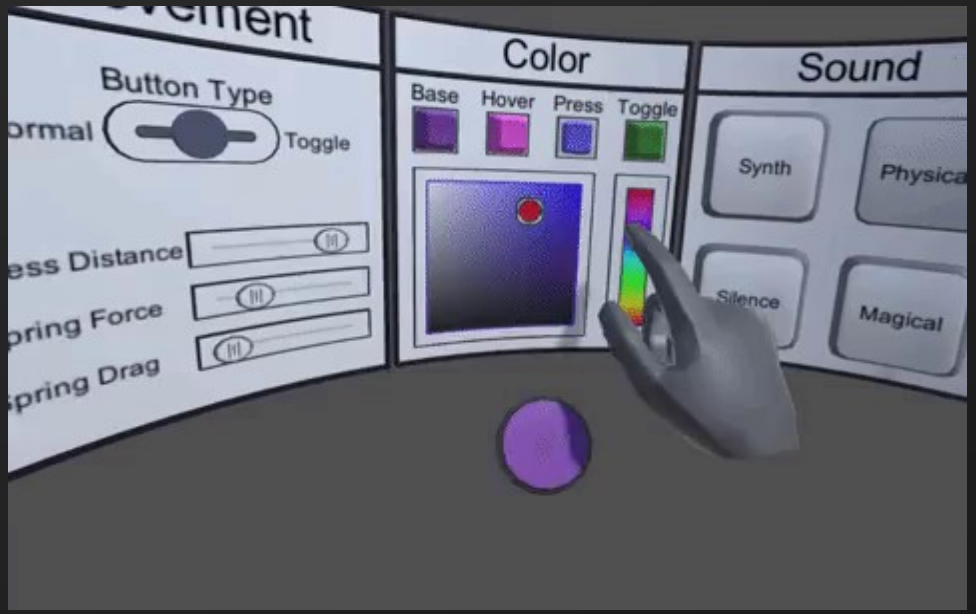
Near future goals

- Virtual Keyboard
- GLTF loading
- Scripting
- G3k Toolkit
- xrdesktop Shell

2D Toolkit integration

- Zero copy access to widget buffers
- GtkOffscreenWindow until gtk3, GdkTexture in gsk
- Input event generation from virtual pointers / keyboards

Native 3DUI



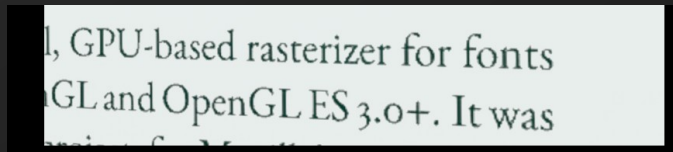
Leap motion demos

Native 3DUI

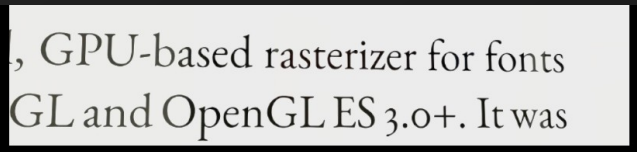
Leap motion demos

Font rendering improvements

- Proxy rendering with HiDPI for desktop windows
- Mozilla Pathfinder (Apache2) in 3DUI



Document in built-in browser



Document in Pathfinder

https://blog.mozvr.com/pathfinder-a-first-look/

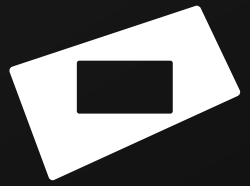
3DUI in WM protocols

- Current applications use game engines for rendering (Unity, Unreal, Godot in FOSS)
- Primitive solution: Projected rendering and depth buffer
- Global scene graph in WM
- Proxy geometry for physics interaction
- Full geometry exchange and centralized renderer for best results

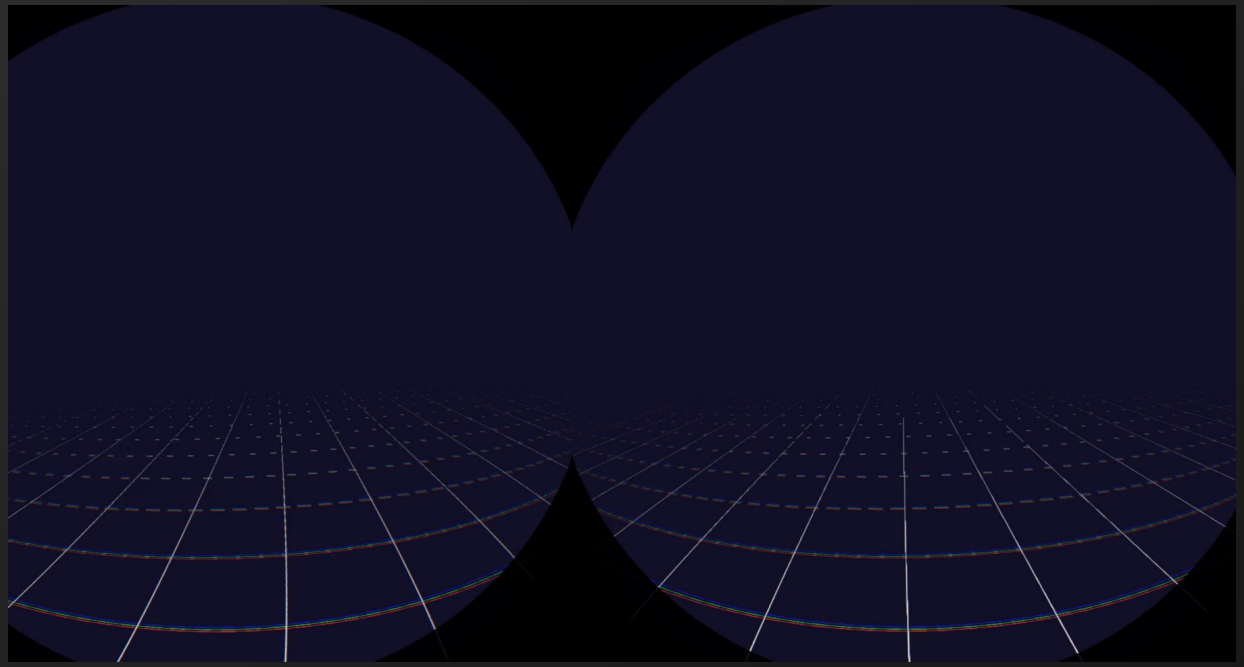
xr_shell_unstable_v1

- Designed by the wxrc project
- Enables compositing of perspectively correct Stereo buffers

```
59  ..<interface name="zxr_shell_v1" version="1">
60  ....<request name="create_composite_buffer">
61  ......<description summary="create a composite buffer">
62  ........Creates a new zxr_composite_buffer_v1. See the documentation for its
63  ........interface for details.
64  ......</description>
65  ......<arg name="id" type="new_id" interface="zxr_composite_buffer_v1" />
66  ....</request>
67
68  ....<request name="get_xr_surface">
69  ......<description summary="create xr surface from a surface">
70  ........This request creates a zxr_surface_v1 for the given surface. This
71  ........assigns the xr_surface role to the surface.
72
```



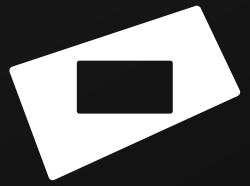
wxrc



https://git.sr.ht/~sircmpwn/wxrc

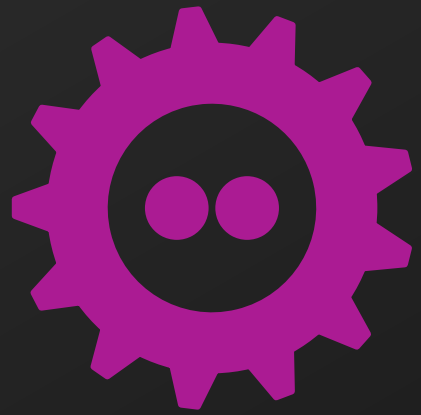
Get Involved

- Chat with us!
  #xrdesktop on Freenode or Discord.
- https://gitlab.freedesktop.org/xrdesktop
- https://twitter.com/xrdesktop



FOSS XR 2020

- End of October in Amsterdam
- Around Blender Conference



Questions?

COLLABORA