The year of the virtual Linux Desktop

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FOSDEM’20
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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)
- Gyroscope, Accelerometer sometimes Magnetometer
- High Frequency
External Optical Tracking

- 6 DoF
SLAM
VR Input
Hand Tracking
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

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-nt.html

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

LGPLv3
https://openslam.org/robotvision.html
https://openslam.org/sa2d.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/lirtlib.html
https://openslam.org/neg-max.html
https://openslam.org/openslam.html
https://openslam.org/orbslam.html
https://openslam.org/opensgslam.html
https://github.com/felixendres/roboslam_v2
https://github.com/opensmap.html
https://github.com/slam6d.html
https://openslam.org/lift.html
https://openslam.org/vertigo.html
https://openslam.org/equ-thin.html
https://openslam.org/lid-sampling.html
https://github.com/2am-vision/lsd_slam
https://github.com/tKUST-Aerial-Robotics/VINS-Mobile

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

BSD
https://github.com/RainerKuemmerle/ogzo
https://openslam.org/omapping.html
https://github.com/aigratik/max-mixture
https://openslam.org/MTK.html
https://github.com/akioshi/learn_velodyne
http://introlab.github.io/rtabmap/
https://github.com/evil0sheep/pci-slam

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

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

Imperial College London / Elastic Fusion 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://github.com/ParallaxBA.html
https://openslam.org/toro.html
https://github.com/lreiemap.html
https://github.com/lufaatslam.html
https://github.com/lrgems.html

OpenSLAM.org License
https://github.com/wd-j-slif.html
https://github.com/rcek/slams.html
https://github.com/dpslam.html
https://github.com/rgidslam.html
https://github.com/bailey-slam.html
https://github.com/slam.html

https://openslam.org
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

X: 2.010302 Y: -3.028566 Z: -14.321749
The desktop in VR
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

```json
... "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"
  }
]..."
3D

Toggle Menu

Push / Pull
Scale

Right Click

Scroll
Left Click

2D

press Grab Window
press Reset Orientation

click UI Click

squeeze Open Keyboard
xrdesktop under the hood
Our Stack
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

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

```xml
   ...<interface name="zxr_shell_v1" version="1">
   ... <request name="create_composite_buffer">
   ...  <description summary="create a composite buffer">
   ...   Creates a new zxr_composite_buffer_v1. See the documentation for its interface for details.
   ... </description>
   ...  <arg name="id" type="new_id" interface="zxr_composite_buffer_v1" />
   ... </request>
   ...
   ...
   ...<request name="get_xr_surface">
   ...  <description summary="create xr_surface from a surface">
   ...   This request creates a xr_surface_v1 for the given surface. This assigns the xr_surface role to the surface.
   ... </description>
```
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?