VR Graphics Programming for, well, you know

Some (relatively) easy steps to virtual reality, Part 3

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What is virtual reality?

Linking the world you made
up to the world you live in.

- Linking head movements to the view matrix.
- Natural interaction modes: pointing, gestures.
- Stereo imagery.
- Immersion.

Input

- Asynchronous input plus
- Continuously tracking equals
- LOTS of events.

MinVR

Flexible display structure Configurable display node tree.

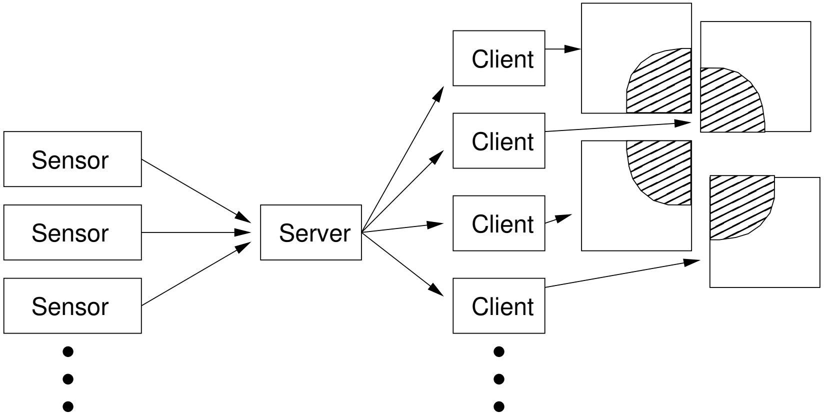
Flexible events You can look at them.

Varying network geometry Supports networked, not networked, etc.

Extensible Plugin architecture using dynamic libraries.

Configurable Most network/hardware/graphics changes can be accommodated at runtime through a configuration file.

MinVR Server/Client Structure

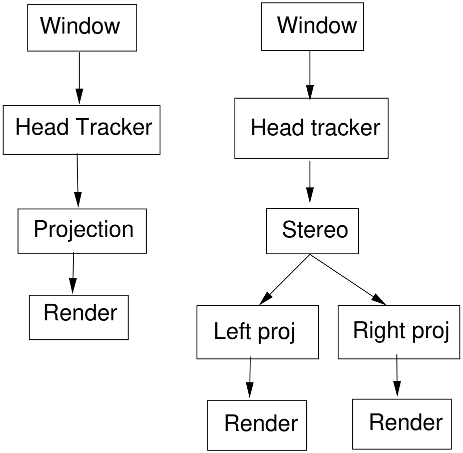


“data”
“data”
“data”

“Are you ready?”
“Here’s the data”
“Swap”

MinVR Display Graph

- Simple desktop display on left
- Stereo YURT nodes on right
- “Render” refers to the user’s render function.



MinVR Data Index

- Hierarchical collection of names and data.
- Supports VRFloat, VRInt, VRString, VRFloatArray, VRIntArray, VRStringArray.
- And VRContainer, which defines a “name space.”
- Use exists() and getValue().
- Has a “state” that can be pushed and popped.
- Used for events and render state. Also configuration files, using an XML parser.

MinVR Display Graph in practice

```
<displayNode:/MinVR/Desktop/RootNode>
|   Type: VRGraphicsWindowNode
|   Values Added:
|     WindowWidth
|     WindowHeight
|   Values Needed:
|      <none>
| <displayNode:/MinVR/Desktop/RootNode/HeadTrackingNode>
|  |   Type: VRHeadTrackingNode
|  |   Values Added:
|  |     HeadMatrix
|  |     CameraMatrix
|  |   Values Needed:
|  |      <none>
|  | <displayNode:/MinVR/D...RootNode/HeadTrackingNode/ProjectionNode>
|  |  |   Type: VRProjectionNode
|  |  |   Values Added:
|  |  |     ViewMatrix
|  |  |     ProjectionMatrix
|  |  |   Values Needed:
|  |  |     CameraMatrix (required)
```

MinVR blah blah blah. How do I use it?

- Make something to implement the VREventHandler and VRRenderHandler interfaces.
- i.e. write an onVREvent() function, onVRRenderContext(), and onVRRenderScene().
- Create a MinVR::VRMain object, use it to add the event and render handlers and initialize it.

MinVR Can you be more specific?

Use MVRDemo.h

```
class MVRDemo : public MinVR::VREventHandler,
  public MinVR::VRRenderHandler {

  typedef MinVR::VRDataIndex VRState;

  MVRDemo(int argc, char** argv);
  virtual void onVREvent(const MinVR::VREvent &eventData);
  virtual void onRenderContext(const VRState& stateData);
  virtual void onRenderScene(const VRState& stateData);

  void run() { while (_main->mainloop()) {} };

  int getLeftoverArgc() { return _main->getLeftoverArgc(); };
  char** getLeftoverArgv() { return _main->getLeftoverArgv(); };
};
```

MinVR: do it like this

```
MVRDemo(int argc, char** argv) {

  _main = new MinVR::VRMain();

  _main->addEventHandler(this);
  _main->addRenderHandler(this);
  _main->initialize(argc, argv);
}
```

MinVR event handler

```
void onVREvent(const MinVR::VREvent &event) {

  // std::cout << "Hearing event:" << event << std::endl;

  if (event.getName() == "KbdEsc_Down") {
    shutdown();
  } else if (event.getName() == "FrameStart") {
    _oscillator = event.getValue("ElapsedSeconds");
  }
}
```

MinVR Events

Some typical events:

```
Hearing event:FrameStart
 | AnalogValue = 10.598754 (float)
 | ElapsedSeconds = 10.598754 (float)
 | EventType = AnalogUpdate (string)

Hearing event:Mouse_Move
 | EventType = CursorMove (string)
 | NormalizedPosition = 0.901563,0.693750 (floatarray)
 | Position = 577.000000,444.000000 (floatarray)

Hearing event:Head_Move
 | EventType = TrackerMove (string)
 | Transform = 0.550934,-0.557136,-0.621348,0.000000,0.727462,0.685475,0.03
```

MinVR render context

```
void onVRRenderContext(const VRState &renderState) {

  // std::cout << "entering graphics context:" << renderState << s

  for (int i = 0; i < _lines.size(); i++) {
    _lines[i].startAnim(plugPos(mrand.get(10),mrand.get(10)));
    _lines[i].step();
  }

  if ((int)renderState.getValue("InitRender") == 1) {
    _checkContext();
    _initializeScene();
    _scene.prepare();
  }
  _scene.load();
}
```

MinVR render scene

```
void onVRRenderScene(const VRState &renderState) {

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT | GL_STENCII

    std::vector<float> pm =
      renderState.getValue("ProjectionMatrix");
    glm::mat4 proj = glm::mat4( pm[0], pm[1], pm[2], pm[3],
                                pm[4], pm[5], pm[6], pm[7],
                                pm[8], pm[9], pm[10],pm[11],
                                pm[12],pm[13],pm[14],pm[15]);
    ...
    _scene.draw(view, proj);
  }
```

Getting and building MinVR

```
$ git clone -b beta https://github.com/MinVR/MinVR
$ cd MinVR
$ mkdir build
$ cd build
$ cmake .. -DWITH_DOCUMENTATION=ON
           -DWITH_PLUGIN_FREEGLUT=ON
           -DWITH_PLUGIN_GLFW=ON
           -DWITH_PLUGIN_OPENGL=ON
$ make install
```

Attach it to your demo-graphic build after defining MINVR_ROOT to point to the INSTALL directory.

```
$ git clone https://github.com/tsgouros/demo-graphic
$ cd demo-graphic
$ mkdir build
$ cd build
$ cmake .. -DMINVR_INSTALL_DIR=${MINVR_ROOT}
           -DBUILD_DOCUMENTATION=ON
```

MinVR Plugins

MinVR

MinVR

MinVR