



**RECOGNITION
ROBOTICS**

The Visual Guidance Company

Immediate Mode Graphical User Interfaces in C++

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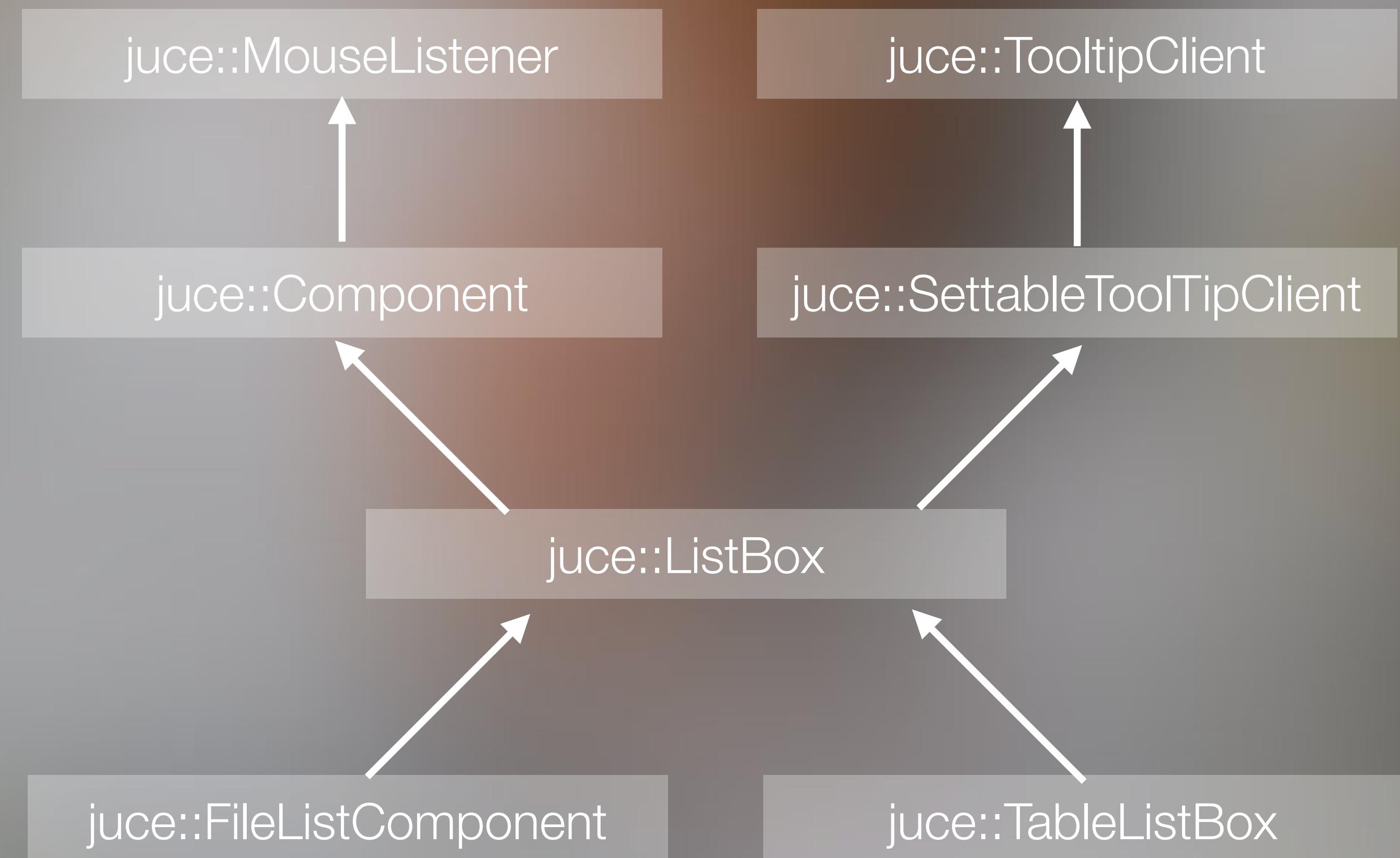
Immediate Mode?

Retained Mode

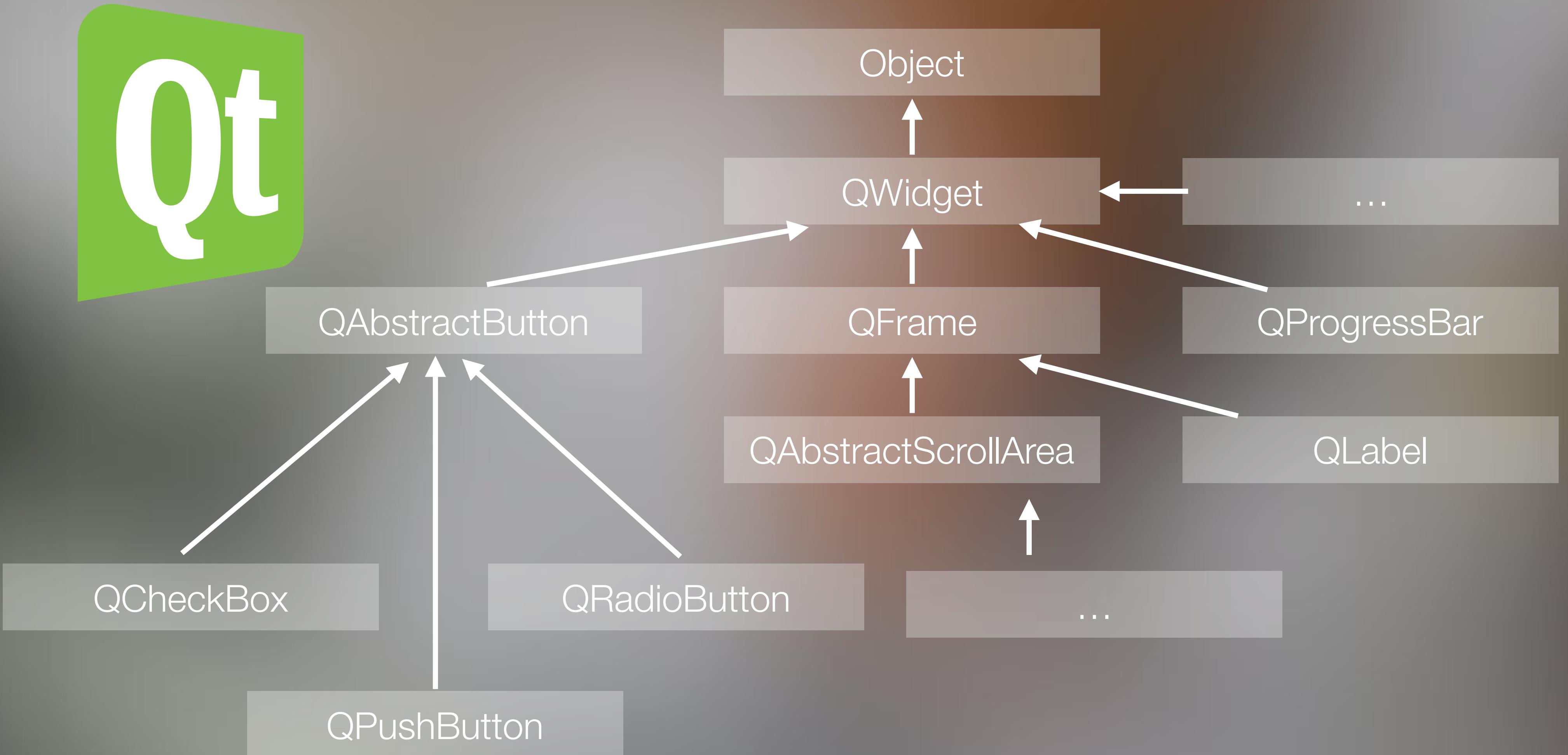
Retained Mode

- Inheritance or Composition Hierarchy
- Object Oriented
- Stateful
- Handle input using callbacks
- Redraw only changed

Retained Mode Hierarchy



Retained Mode Hierarchy



Retained Mode Object Orientation

View

TextBox Instance

X : ...

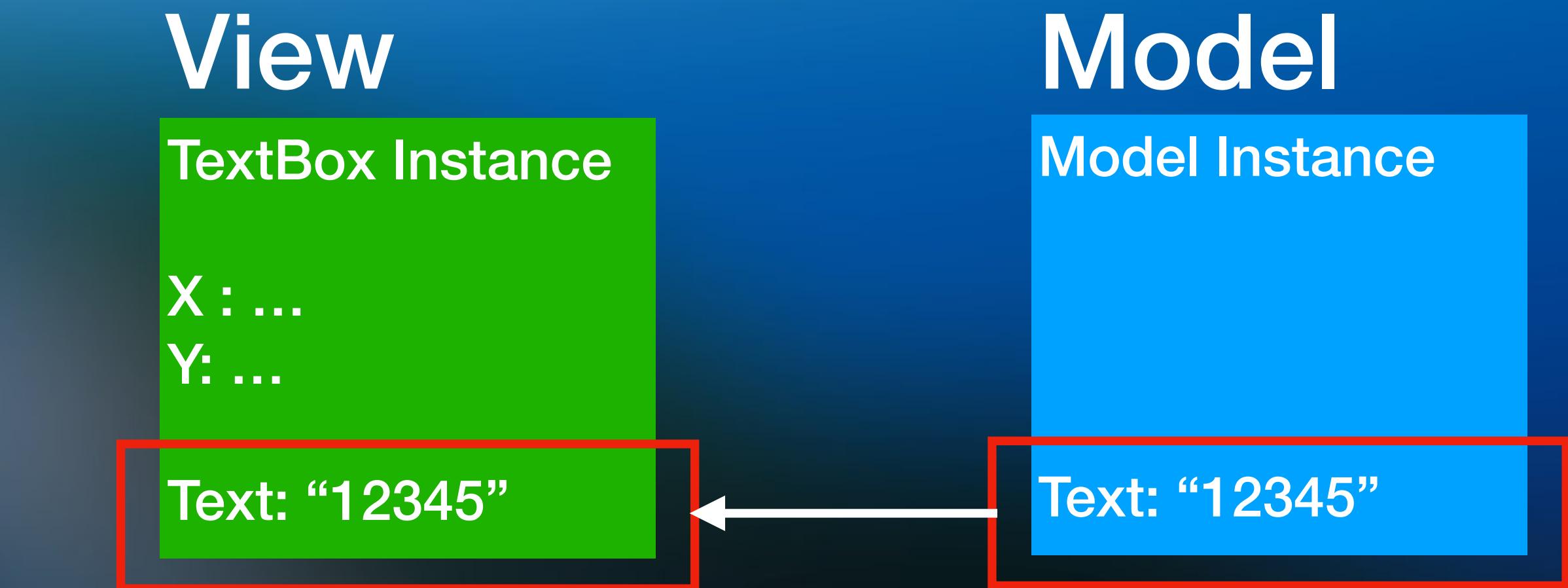
Y: ...

```
// During window opening
TextBox* textBox = new TextBox();
window->addControl(textBox);
// ...

// During window closing
delete textBox;
```

Retained Mode Statefulness

```
// ...  
  
textBox->setName("Text");  
textBox->setText(model->text);  
  
// ...
```



Retained Mode Toolkits

Prefer Inheritance:

- Qt Widgets
- JUCE
- Windows Forms
- iOS / macOS Cocoa (UIKit / AppKit)
- Android UI
- WxWidgets
- ...

Prefer Composition:

- HTML5 DOM
- Qt Quick (QML)
- WPF
- ...

Immediate Mode

Immediate Mode

- Stateless
- Function Oriented
- Handle Inputs and Graphics in line
- Redraw everything all the time

Immediate Mode Stateless nature

Model

Model Instance

Text: “12345”

```
//...There is no textBox object  
  
InputText("Text", &model->text);  
  
//...no one keeps copy of model data
```

InputText function
sizeof(function) == 0?

Immediate Mode Function Oriented Model

```
//... There is no textBox class  
  
InputText("Text", &model->text);  
  
//... Only a function call
```

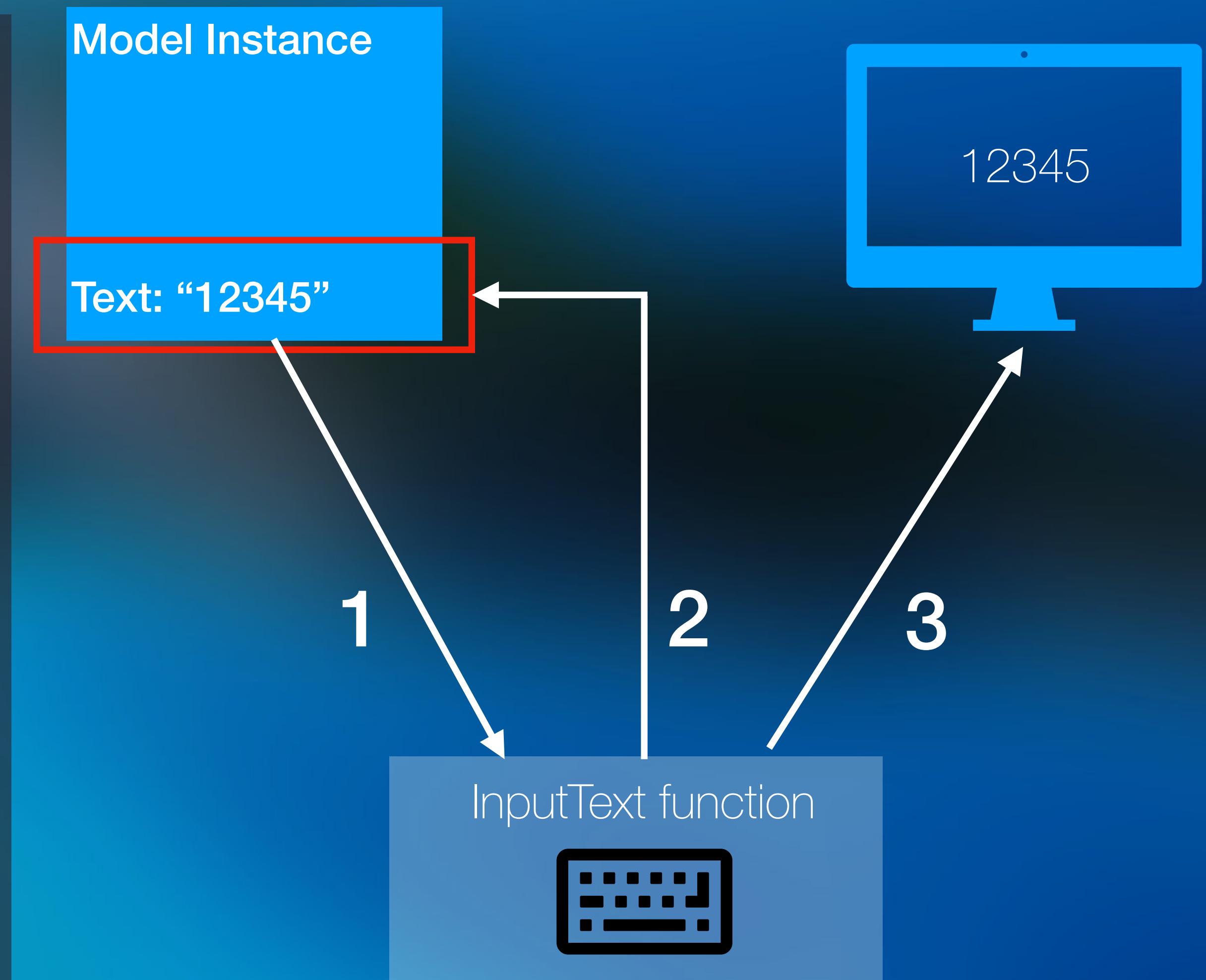
Model Instance

Text: "12345"

InputText function

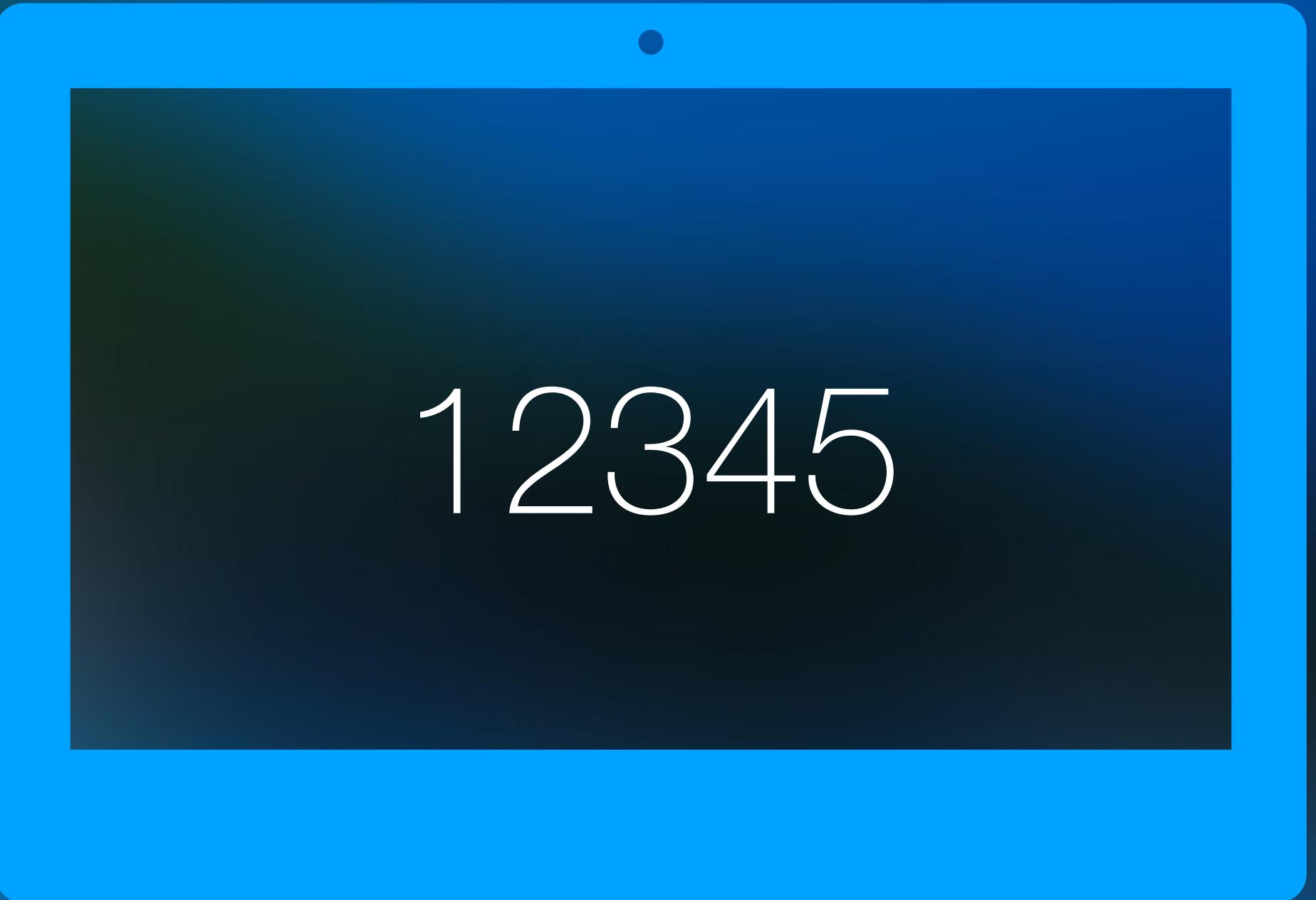
Immediate Mode Inputs and Graphics

```
//... Inputs original model state  
InputText("Text", &model->text);  
  
//... Outputs modified model state  
//... Outputs graphics to show state
```



Immediate Mode Draw Every Frame

```
//...Call input text 60 times/second  
InputText("Text", &model->text);  
  
//...Obtain 60 FPS User Interface
```



Advantages

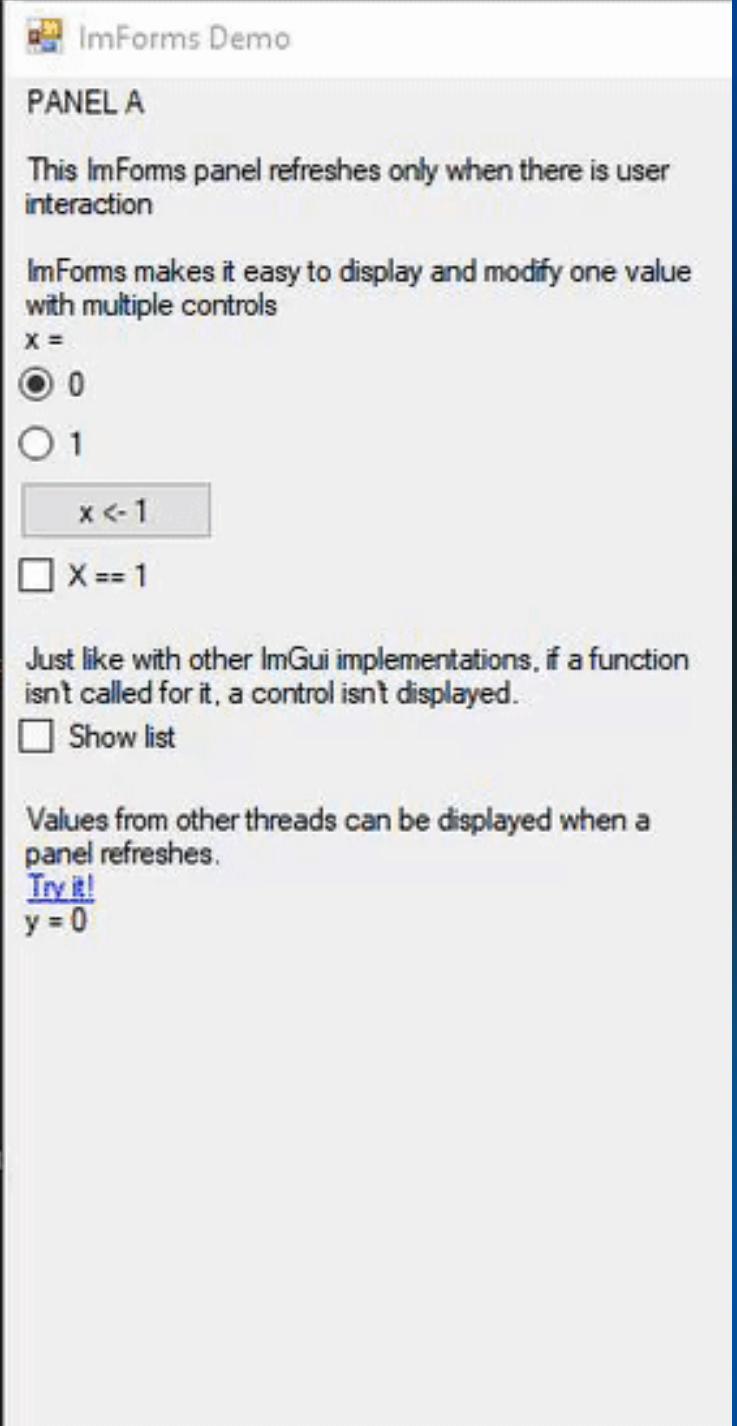
Immediate Mode Advantages

- Less Code
- Lower complexity
- Always in sync (by definition)
- Dynamic Layouts

Disadvantages

Immediate Mode Disadvantages

- Can't (easily) use form designers
- No complete native toolkit exists (as of today)
- Nice:
<https://github.com/HMNBadBoyz/ImForms>
Windows.Forms imgui-ized API in C#
(Just spotted yesterday!)



```
mgr.Label("ImForms makes it easy to display and modify one value with multiple controls");
mgr.Label("x = ");
mgr.RadioButton("0", ref x, 0);
mgr.RadioButton("1", ref x, 1);

int valueToAssignX = (x == 1) ? 0 : 1;
if (mgr.Button("x <- " + valueToAssignX, CompileTime.ID()))
{
    x = valueToAssignX;
}

bool xIs1 = (x == 1);
mgr.Checkbox("X == 1", ref xIs1);
x = xIs1 ? 1 : 0;

mgr.Space(CompileTime.ID());
mgr.Label("Just like with other ImGui implementations, if a function isn't called for it, a control isn't displayed.");
mgr.Checkbox("Show list", ref displayList);

if (displayList)
{
    var seq = reverseList ? list.Reverse() : list;
    foreach (var n in seq) { mgr.Label("[ " + n + "]"); }

    if (mgr.Button("Add to end")) { list.Add(list.LastOrDefault()); }

    if (mgr.Button("Remove from front")) { list.RemoveAt(0); }

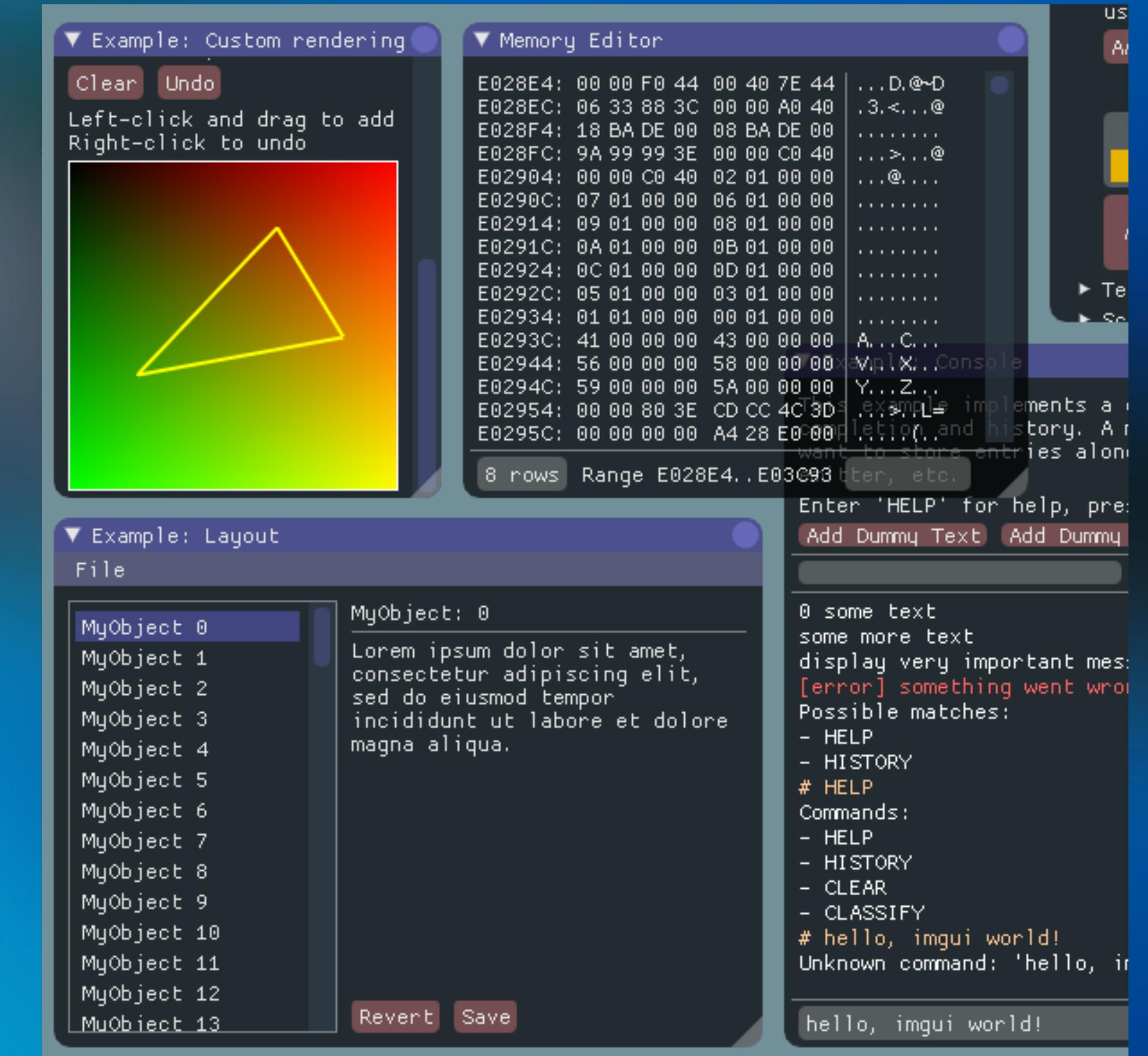
    mgr.Checkbox("Display reversed", ref reverseList);
}
```

PANEL A
This ImForms panel refreshes only when there is user interaction
ImForms makes it easy to display and modify one value with multiple controls
x =
 0
 1
x <- 1
 X == 1
Just like with other ImGui implementations, if a function isn't called for it, a control isn't displayed.
 Show list
Values from other threads can be displayed when a panel refreshes.
[Try it!](#)
y = 0

Dear ImGUI

Dear ImGUI

- Written by Omar Cornut
- Bloat free
- Orthodox C++ Style
- Open Source, MIT
- GameDev Oriented
- Extremely portable
- Outputs textured triangles
- Auto Layout



Example - Application model

```
#include <array>
class TutorialModel
{
public:
    char str[50]          = "empty"; // Please forgive me
    int number            = 0;
    float floatNumber    = 0.0f;
    bool booleanOption   = false;
    enum class SomeOption : int
    {
        Option1 = 0,
        Option2 = 1,
        Option3 = 2,
    };
    SomeOption option = SomeOption::Option1;
};

TutorialModel model;
```

Dear ImGui - Text

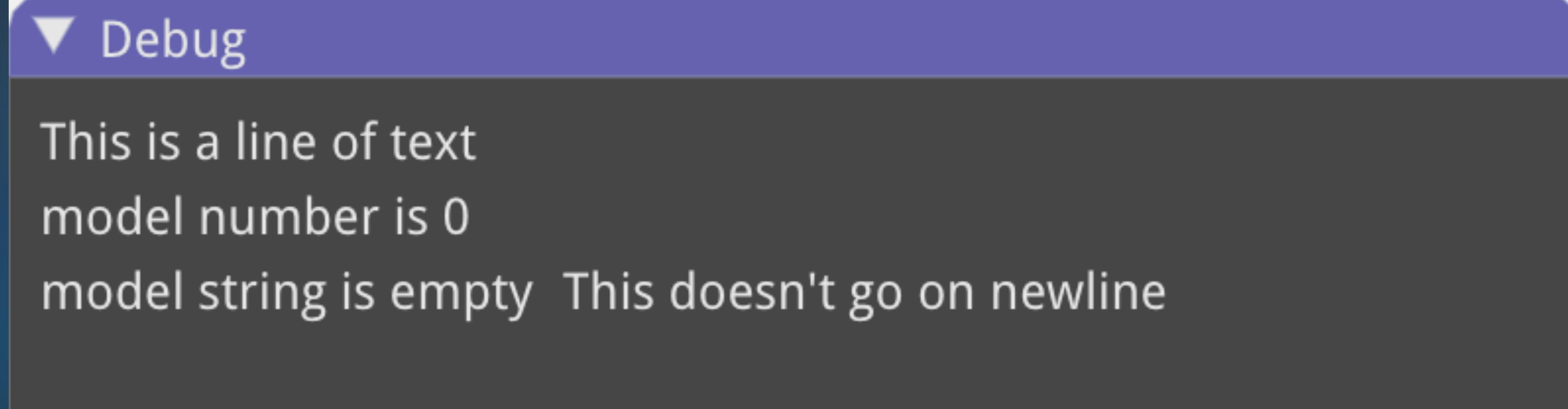
```
ImGui::Text("This is a line of text");

ImGui::Text("model number is %d", model.number);

ImGui::Text("model string is %s", model.str);

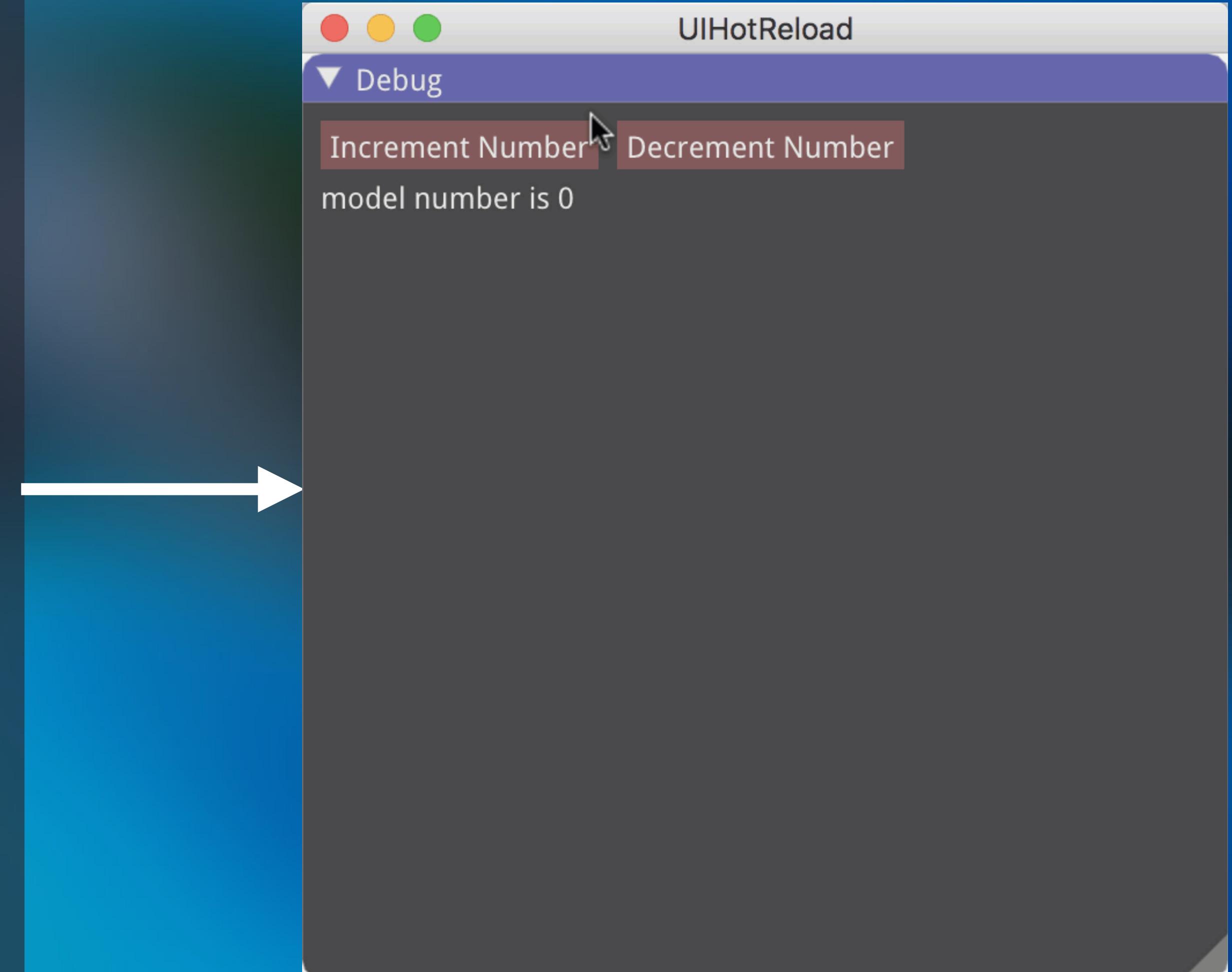
ImGui::SameLine();

ImGui::Text("This doesn't go on newline");
```



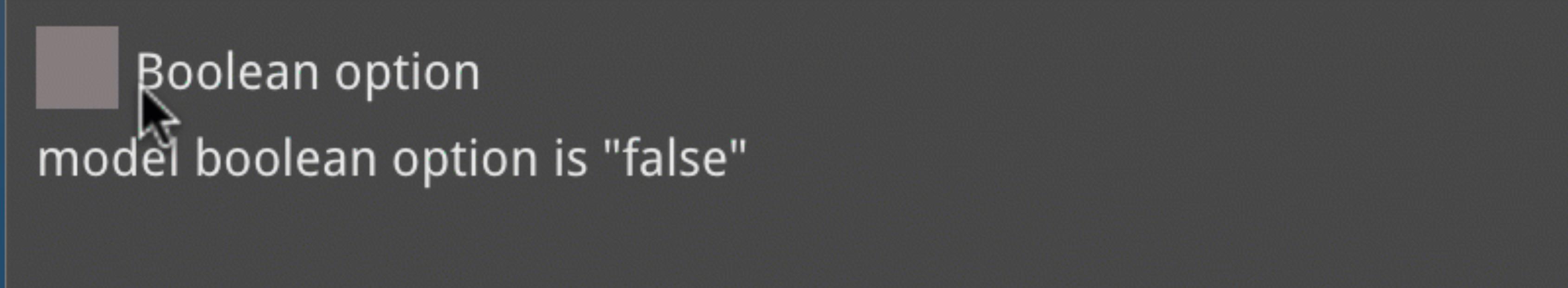
Dear ImGui - Buttons

```
if (ImGui::Button("Increment Number"))
{
    model.number++;
}
ImGui::SameLine();
if (ImGui::Button("Decrement Number"))
{
    model.number--;
}
ImGui::Text("model number is %d",
model.number);
```



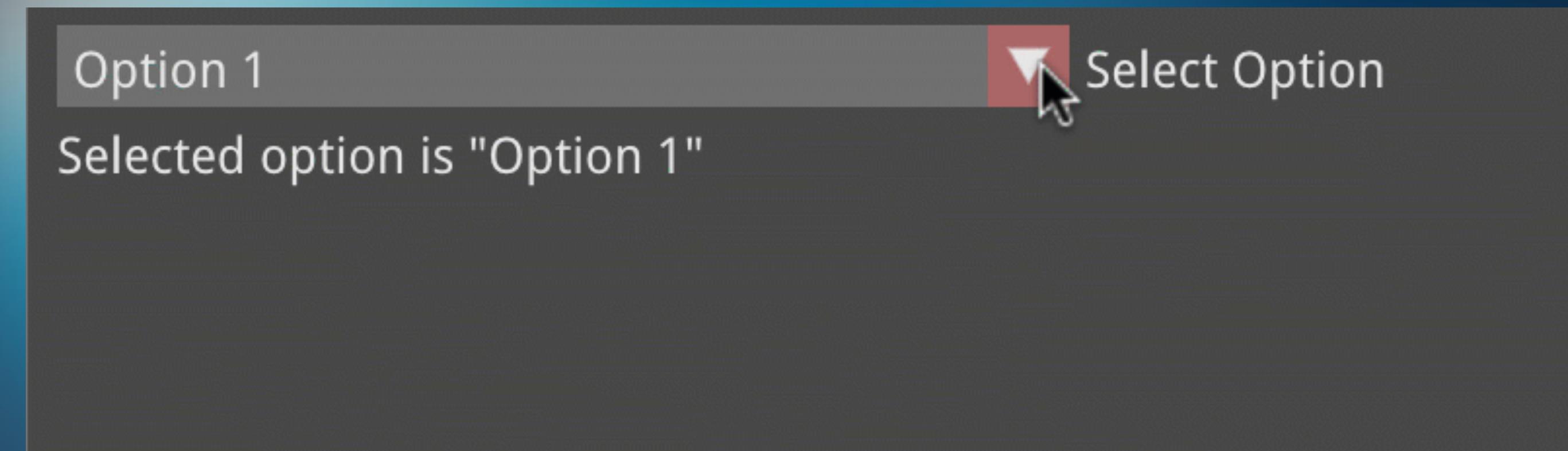
Dear ImGui - Checkbox

```
ImGui::Checkbox("Boolean option", &model.booleanOption);  
  
ImGui::Text("model boolean option is \"%s\"", model.booleanOption ? "true" :  
"false");
```



Dear ImGui - Combo

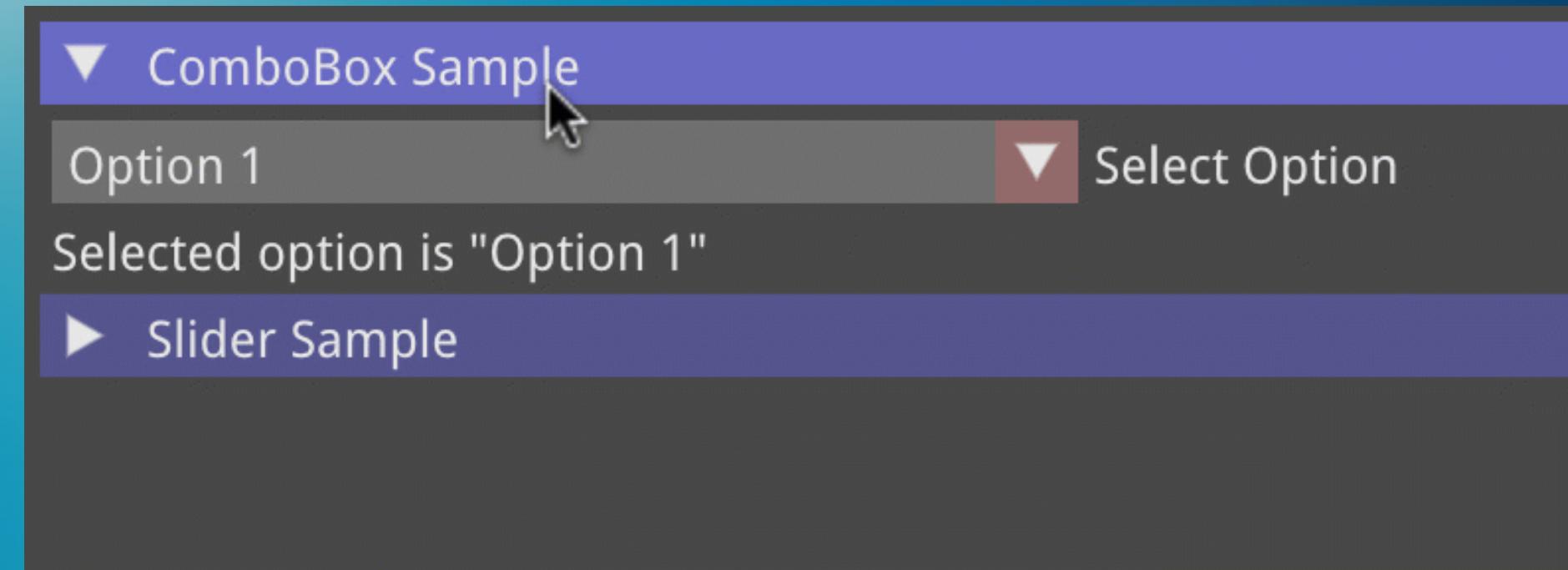
```
std::array<const char*, 3> option_names = {"Option 1", "Option 2", "Option 3"};  
  
ImGui::Combo("Select Option", reinterpret_cast<int*>(&model.option), option_names.data(),  
option_names.size());  
  
ImGui::Text("Selected option is \"%s\"", option_names[static_cast<int>(model.option)]);
```



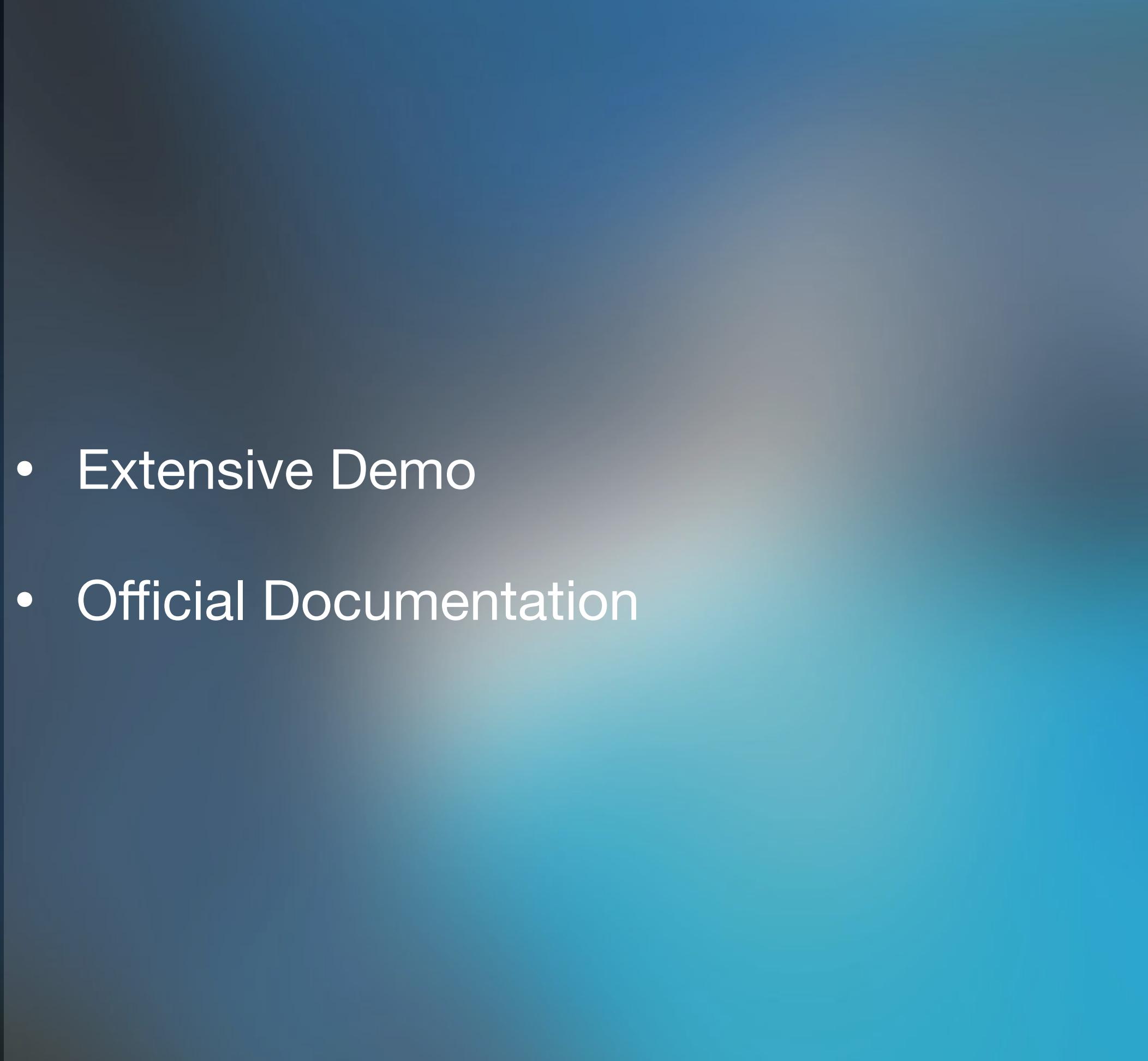
Dear ImGui - Collapsing Header

```
if(ImGui::CollapsingHeader("ComboBox Sample"))
{
    tutorial_combobox();
}

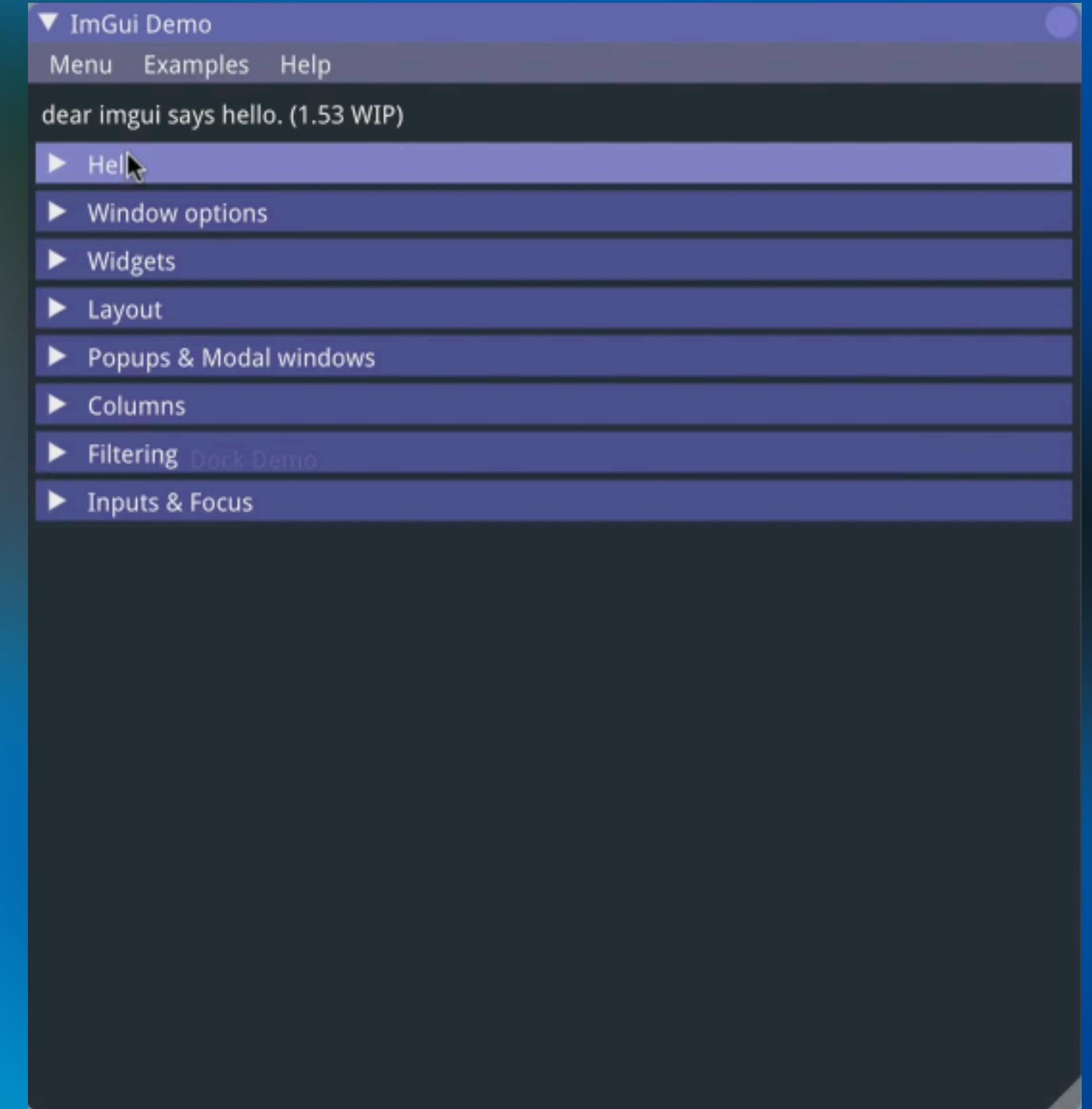
if(ImGui::CollapsingHeader("Slider Sample"))
{
    tutorial_slider_int();
}
```



Dear ImGui - Demo



- Extensive Demo
- Official Documentation



Modern C++?

- Flat C Style API
- List of functions and Flags in a namespace
- Global Static object to track state
- Do we really need `reinterpret_cast<s>`?
- Modern C++ addicts? Create wrappers
- Using ImGui with STL types
<https://eliasdaler.github.io/using-imgui-with-sfml-pt2/#using-imgui-with-stl>

Ideas for a wrapper

- Work out of the box with your application types (strings, arrays etc.)
- CSS like “styles”
- Animations
- Some extended controls

Our Wrapper - General

```
const style iconButton = style().visible(isVisible).disabled(isDisabled).size(150, 35);
if (ui.headerBackgroundBegin("Buttons2", ImVec2(0, 350), style().backgroundColor(ImColor(125, 40, 125,
200)).textColor(white)))
{
    ui.checkbox("Buttons Visible", &isVisible);
    ui.checkbox("Buttons Disabled", &isDisabled);
    ui.button("Button Size (150 x 30)", style().size(150, 30));
    ui.button("Button Disabled",
style().disabled(true).backgroundColor(ColorDarkPrimary).textColor(TextSecondary));
    ui.pushStyle(iconButton);
    ui.button("Button Icon", style(), buttonOptions().icon(ImGui_fa_folder));
    ui.button("Half Width", style().width(0.5));
    ui.button("Full Width", style().width(1).fontScale(2));
    ui.popStyle();
    ui.button("Red Button with white text", style().backgroundColor(red).textColor(white));
    if (ui.button("Open Dialog"))
    {
        ui.openDialog("Confirmation");
    }
    ui.button("Button Text", style().size(halfButton).backgroundColor(blue).textColor(green).rounding(5));
}
ui.headerBackgroundEnd("Buttons2");
```

Our Wrapper - Animation

- Animate windows and child windows
- Size, Position, Color and Alpha
- Currently work In Progress
- Non trivial to fit into immediate mode api

Home page

Page 1

► Buttons2

► Text

► Other Stuff

CurrentPage = Page_Home

FuturePage=Page_Home

Current Slide In/out

Current Fade In/Out

Current Fade and Slide In/Out

future Slide In/out

future Fade In/Out

future Fade and Slide In/Out

Our wrapper - Animation API

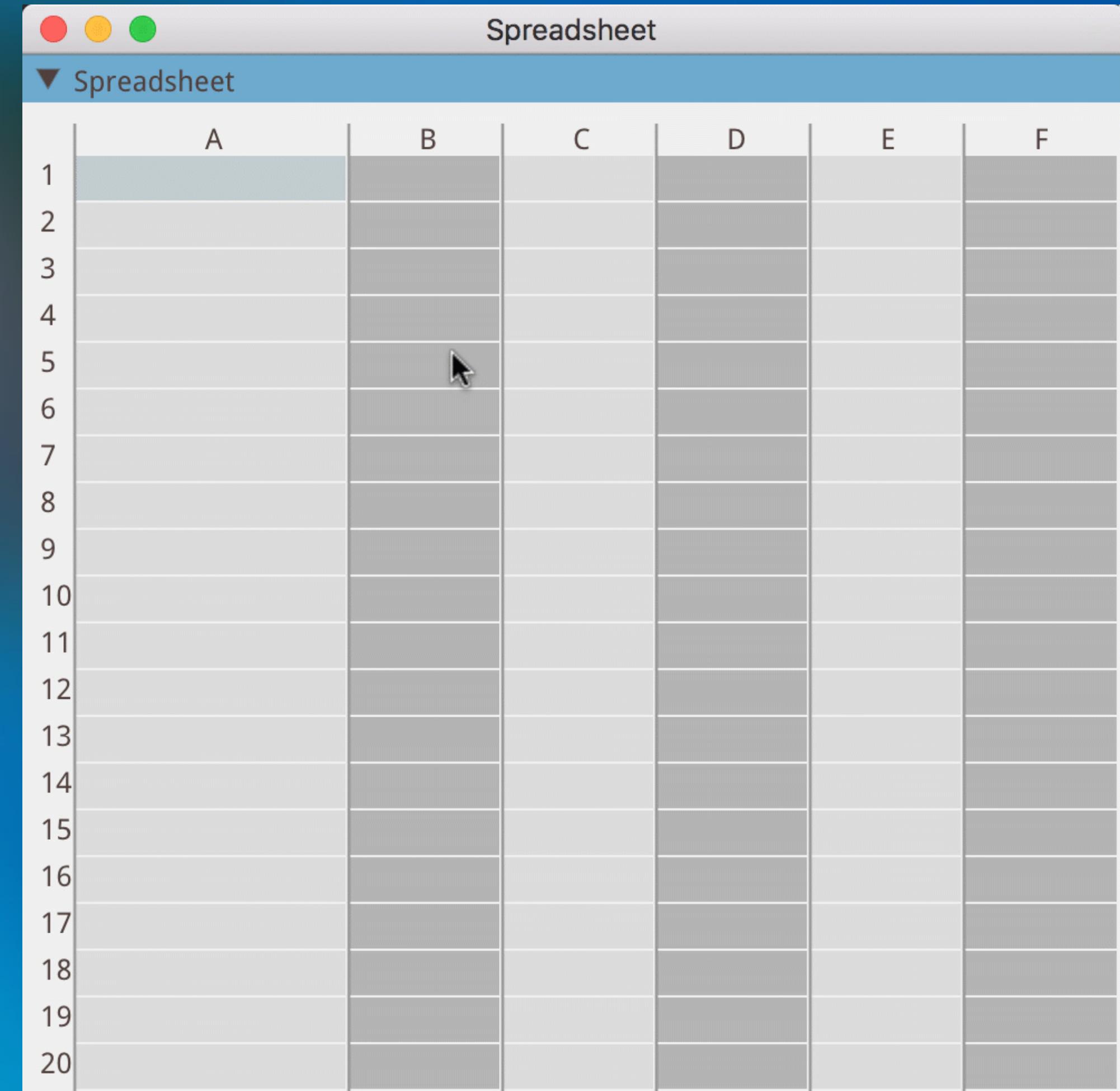
```
if (ui.childWindowBegin(EnumToText(page), ImVec2(250, 0), style().backgroundColor(col)))
{
    ui.h1("Home page", style().textColor(white));
    if (ui.button("Page 1",
                  style().backgroundColor(yellow),
                  buttonOptions().icon(ImGui_fa_folder)))
    {
        futurePage = Page1;
        ui.selectRoot()
            .child(EnumToText(page))
            .animate()
            .slideFromTo(ImVec2(0, 0), ImVec2(-150, 0))
            .during(600);
        ui.selectRoot()
            .child(EnumToText(futurePage))
            .animate()
            .slideFromTo(ImVec2(250, 0), ImVec2(0, 0))
            .during(600);
    }
}
//...
```

Some of our custom controls

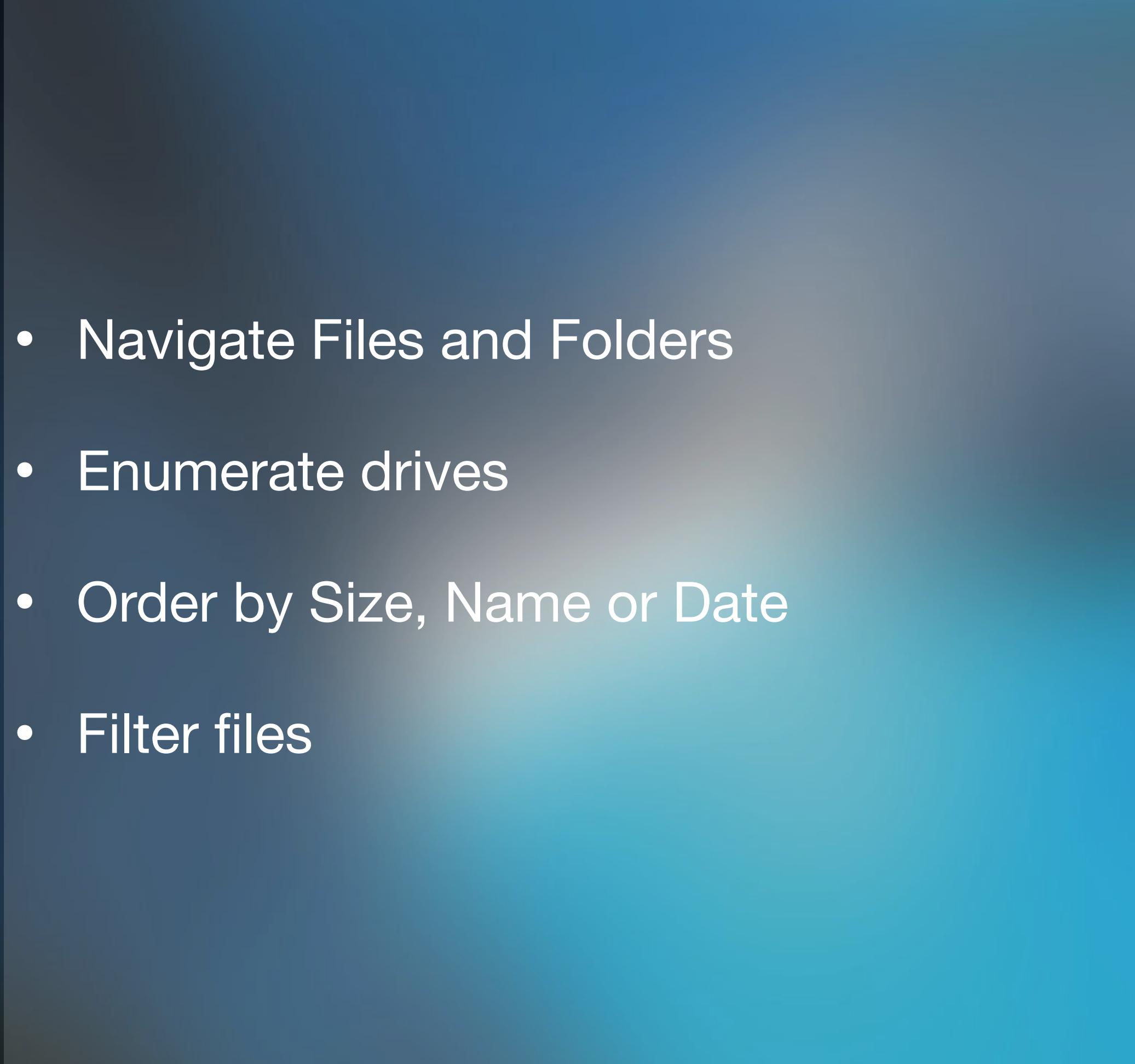
- Spreadsheet
- File Dialogs
- Virtual Keyboard

Our Custom Controls - Spreadsheet

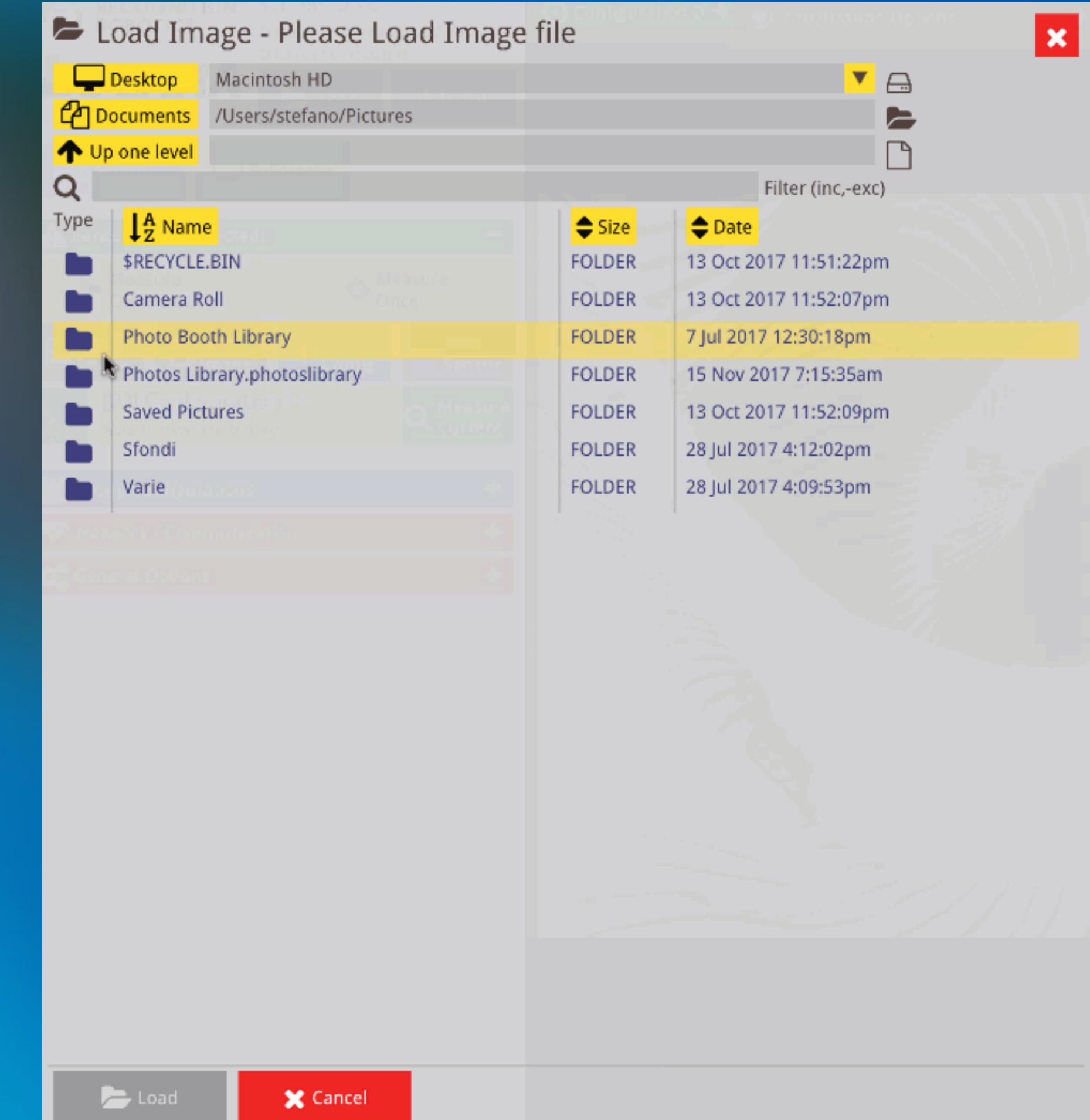
- Proof of concept in few hours
- Fancier features added later
 - Range Variables
 - Dependency Tracking



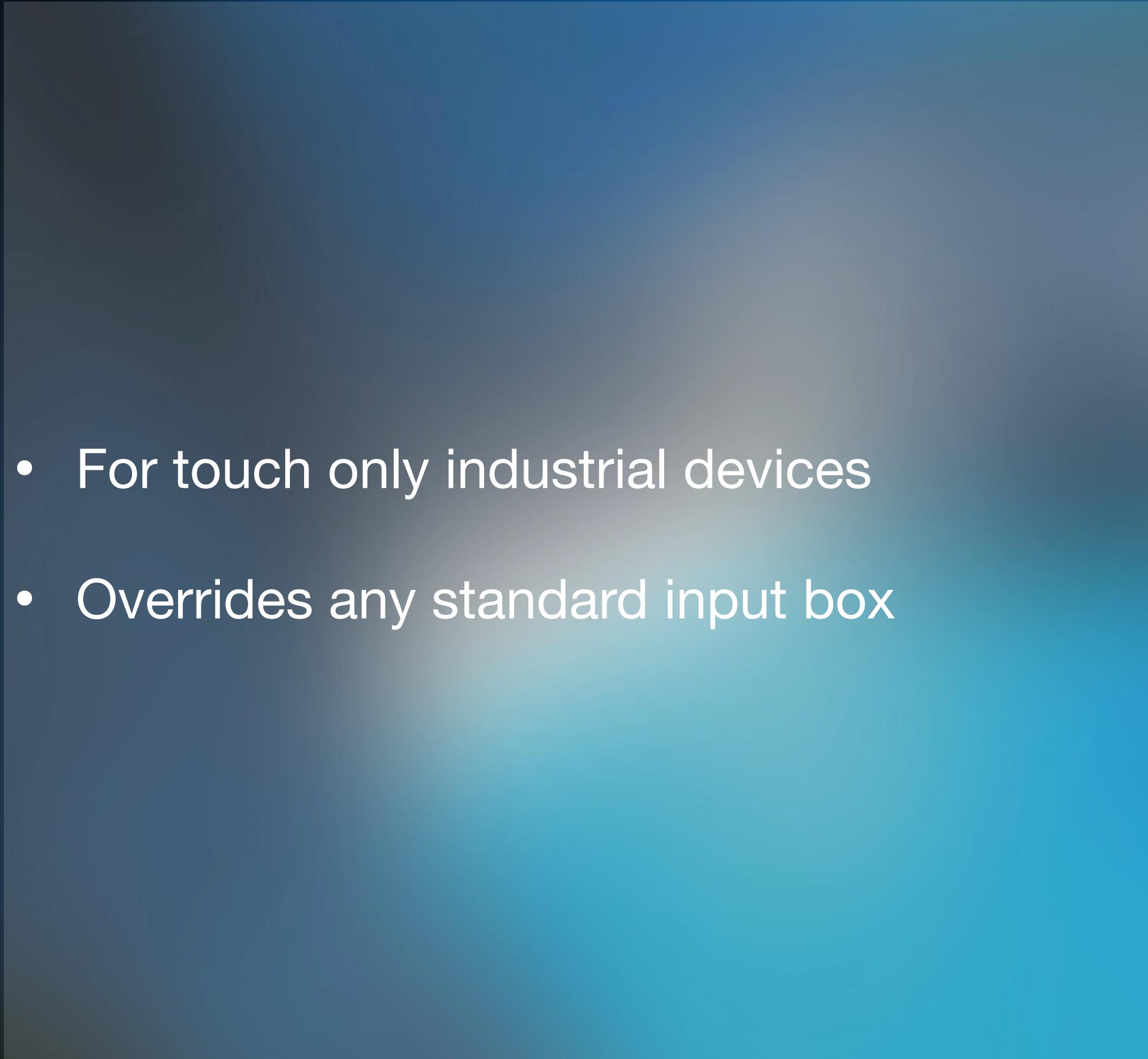
Our Custom Controls - File Dialog



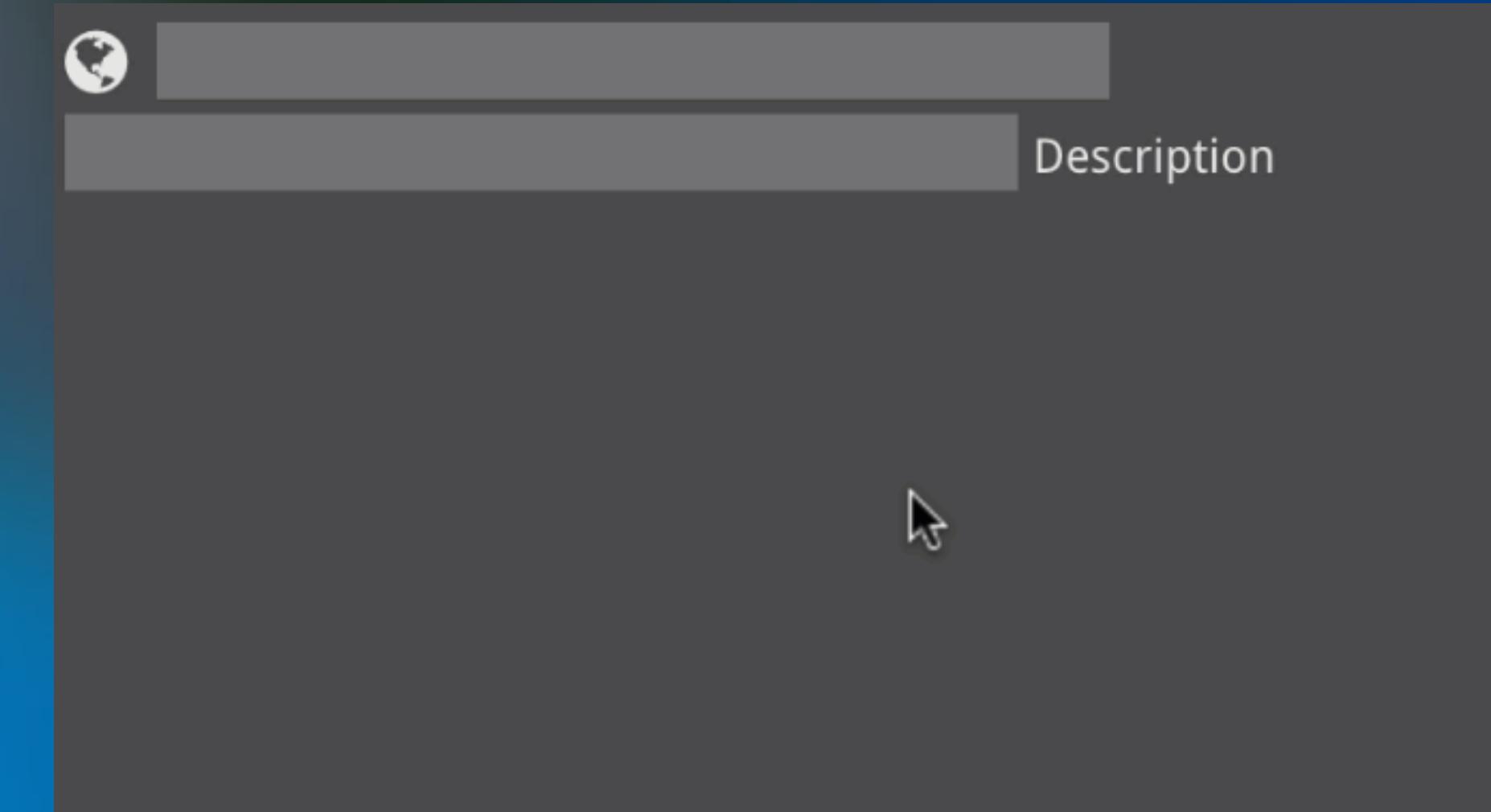
- Navigate Files and Folders
- Enumerate drives
- Order by Size, Name or Date
- Filter files



Our Custom Controls - Virtual Keyboard

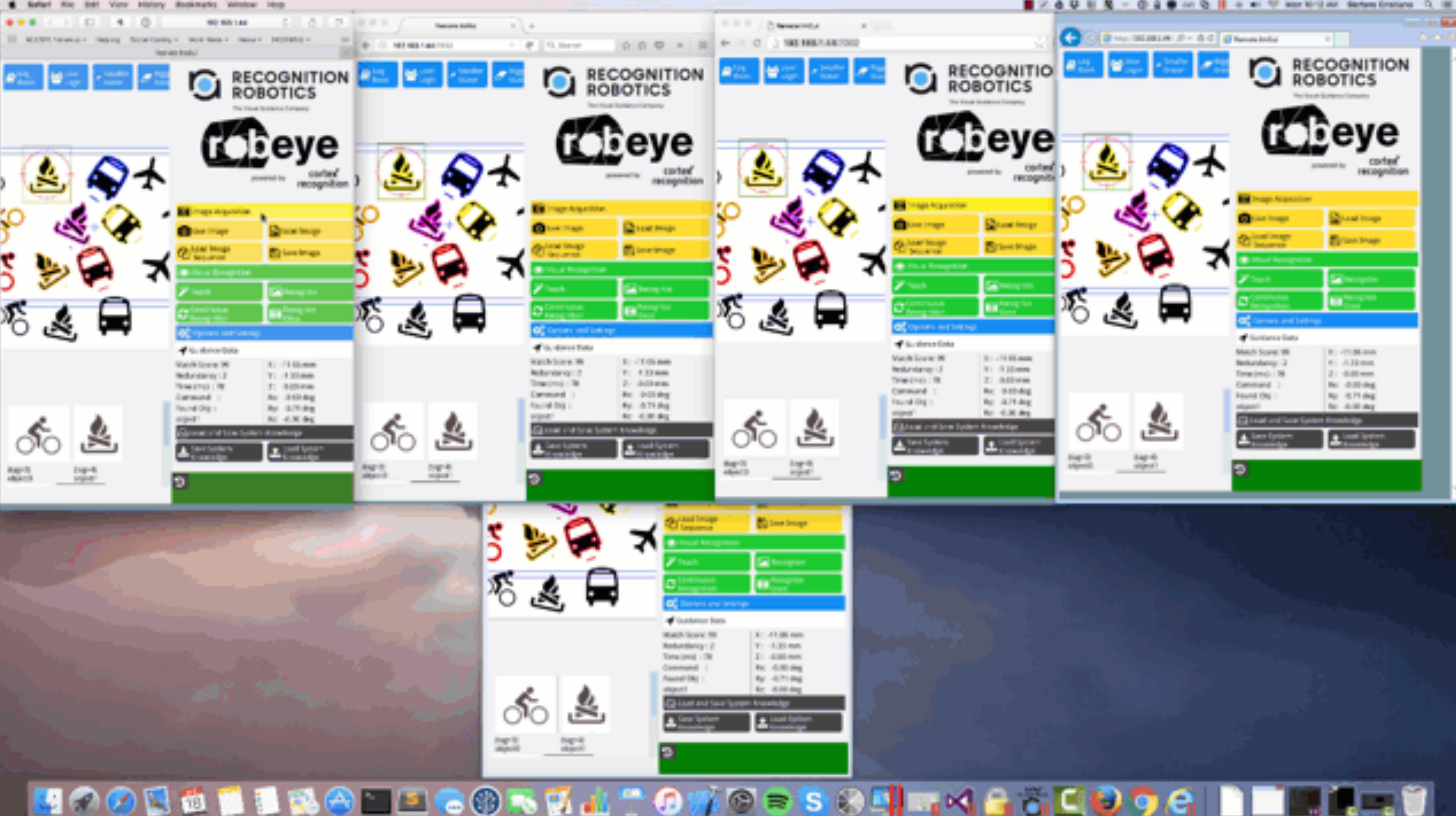


- For touch only industrial devices
- Overrides any standard input box



Dear ImGui - Remoting

- Remote imgui in Browser
- Remote imgui in Native application
- Websocket / WebGL
- Based on the original Idea by JordiRos
(<https://github.com/JordiRos/remoteimgui>)





Sensor Browser

Version 0.1.0

RAIO IP: 127.0.0.1
 MAC: 0000000000

Reachable on current subnet

[Change IP Address](#) [Enable DHCP](#) [File Manager](#)
[Firmware Manager](#) [Remote using RDP](#) [Remote Control](#)
robeye IP: 192.168.1.29
 MAC: 112233445566

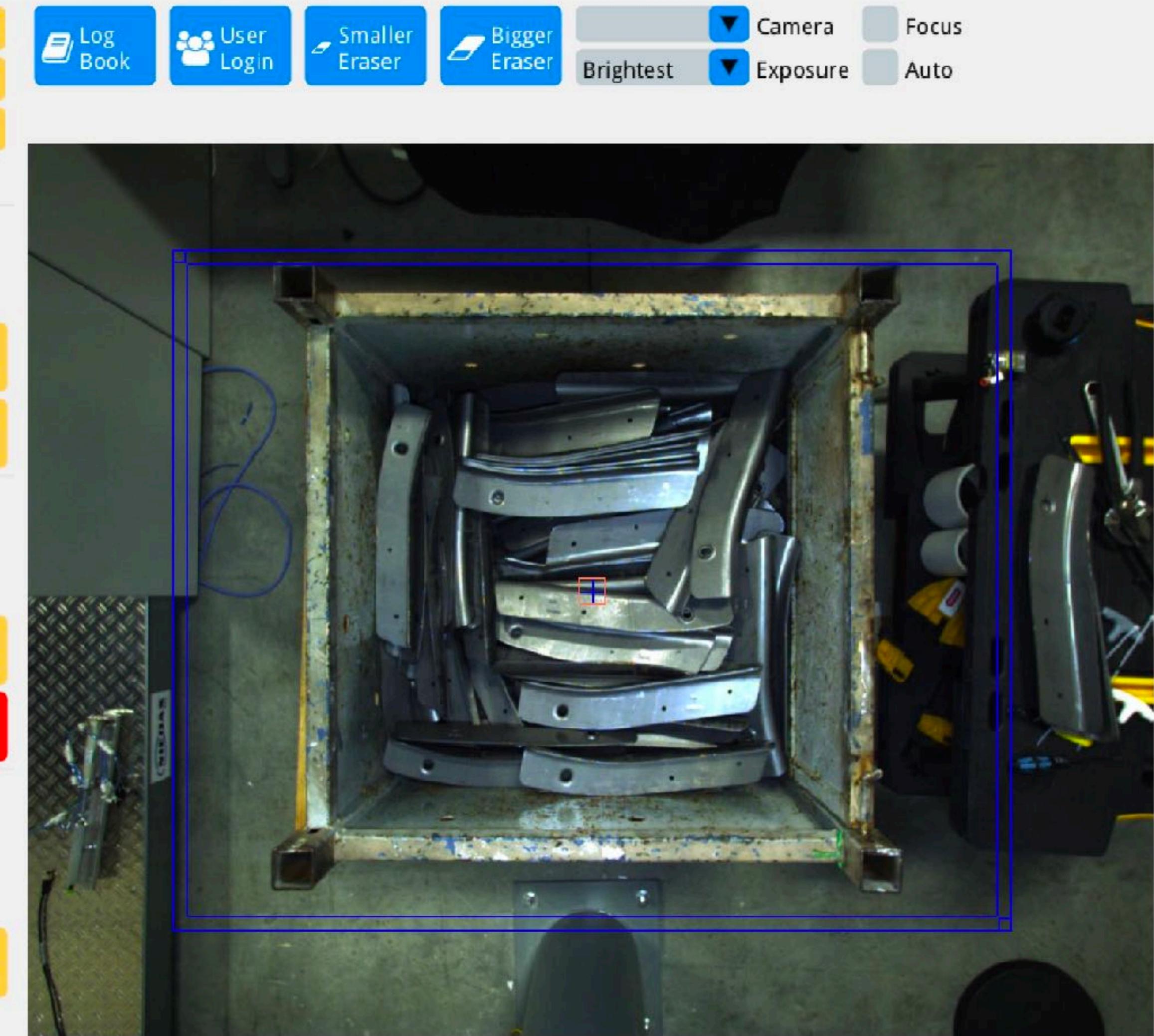
Reachable on current subnet

[Change IP Address](#) [Enable DHCP](#) [File Manager](#)
[Firmware Manager](#) [Remote using RDP](#) [Remote Control](#)
LUCANA abacus IP: 192.168.1.22
 MAC: 332233445544

Reachable on current subnet

[Change IP Address](#) [Enable DHCP](#) [File Manager](#)
[Firmware Manager](#) [Browser Control](#)
cortex
 recognition IP: 192.168.1.25
 MAC: 1133433445544

Reachable on current subnet

[Change IP Address](#) [Enable DHCP](#) [File Manager](#)
[Firmware Manager](#) [Remote using RDP](#) [Remote Control](#)


The Visual Guidance Company

powered by cortex recognition

- Image Acquisition
- Live Image Load Image
- Load Image Sequence Save Image
- Visual Recognition
- Teach Recognize
- Continuous Recognition Recognize Once
- Options and Settings

Guidance Data

Match Score: 0 X: +0.00 mm
 Redundancy : 0 Y: +0.00 mm
 Time (ms) : 0 Z: +0.00 mm
 Command : Rx: +0.00 deg
 Found Obj : Ry: +0.00 deg
 Rz: +0.00 deg

- Load and Save System Knowledge
- Save System Knowledge Load System Knowledge

 Loading ctx file version 103124

RECOGNITION ROBOTICS

Dear ImGui - Live Reload

- Dear ImGui generates UI by running a function
- Put that function in a DLL
- Reload DLL on source change
- Enjoy!
- Compile / Run cycle of ~ 0.5s turnaround
- One possible implementation: <https://github.com/fungos/cr>
- Who needs React Native ? :)

C++ tutorial-controls.cpp

C++ hotReload.cpp

C++ test-controls.cpp X



```
        clickedItem = v;
    }

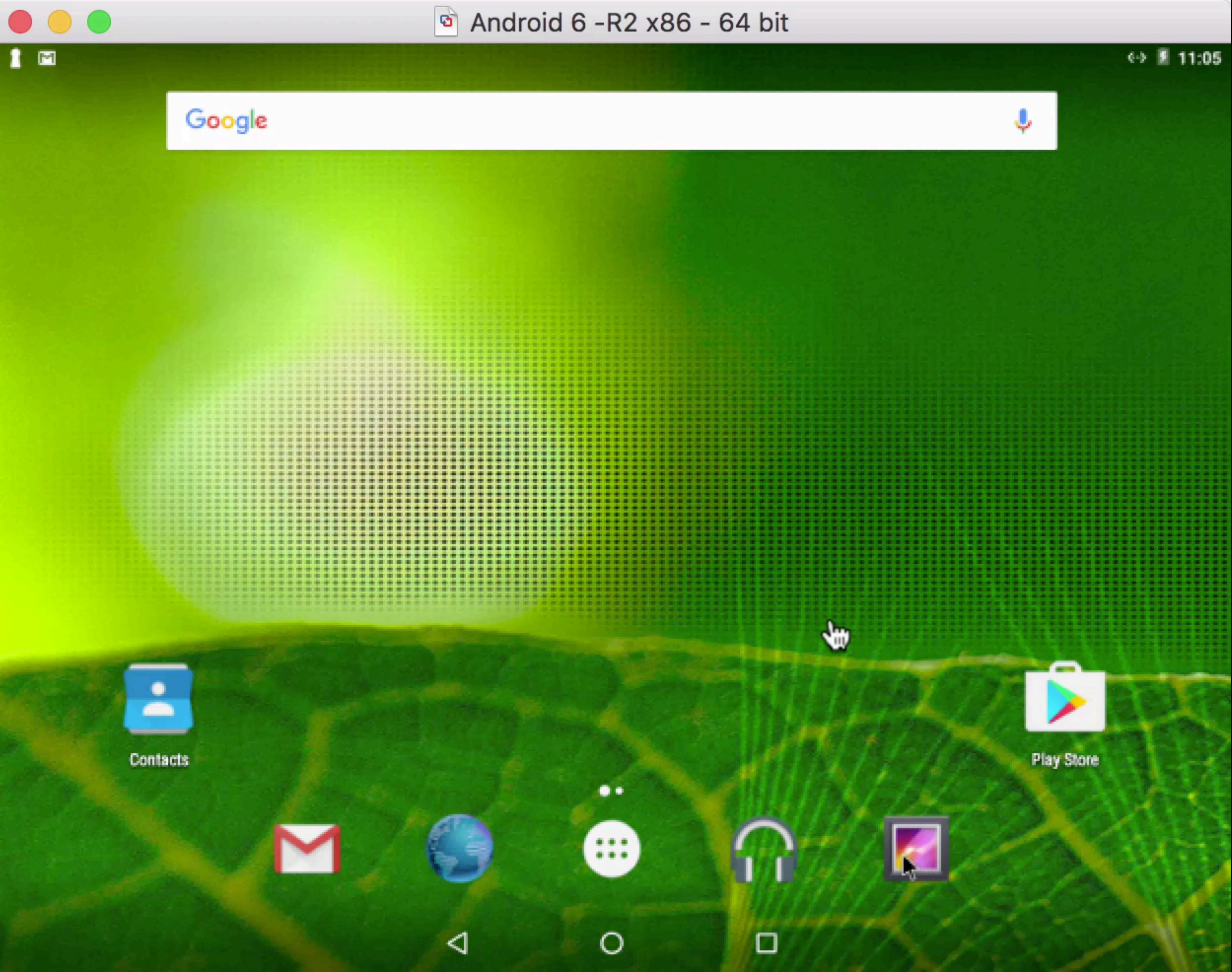
    void test_controls_draw(rrUI::nativeWindow* view)
{
    static Model model;
    using namespace rrUI;
    using namespace rrNode;
    const ImColor red(255, 0, 0, 255);
    const ImColor green(0, 255, 0, 255);
    const ImColor blue(0, 0, 255, 255);

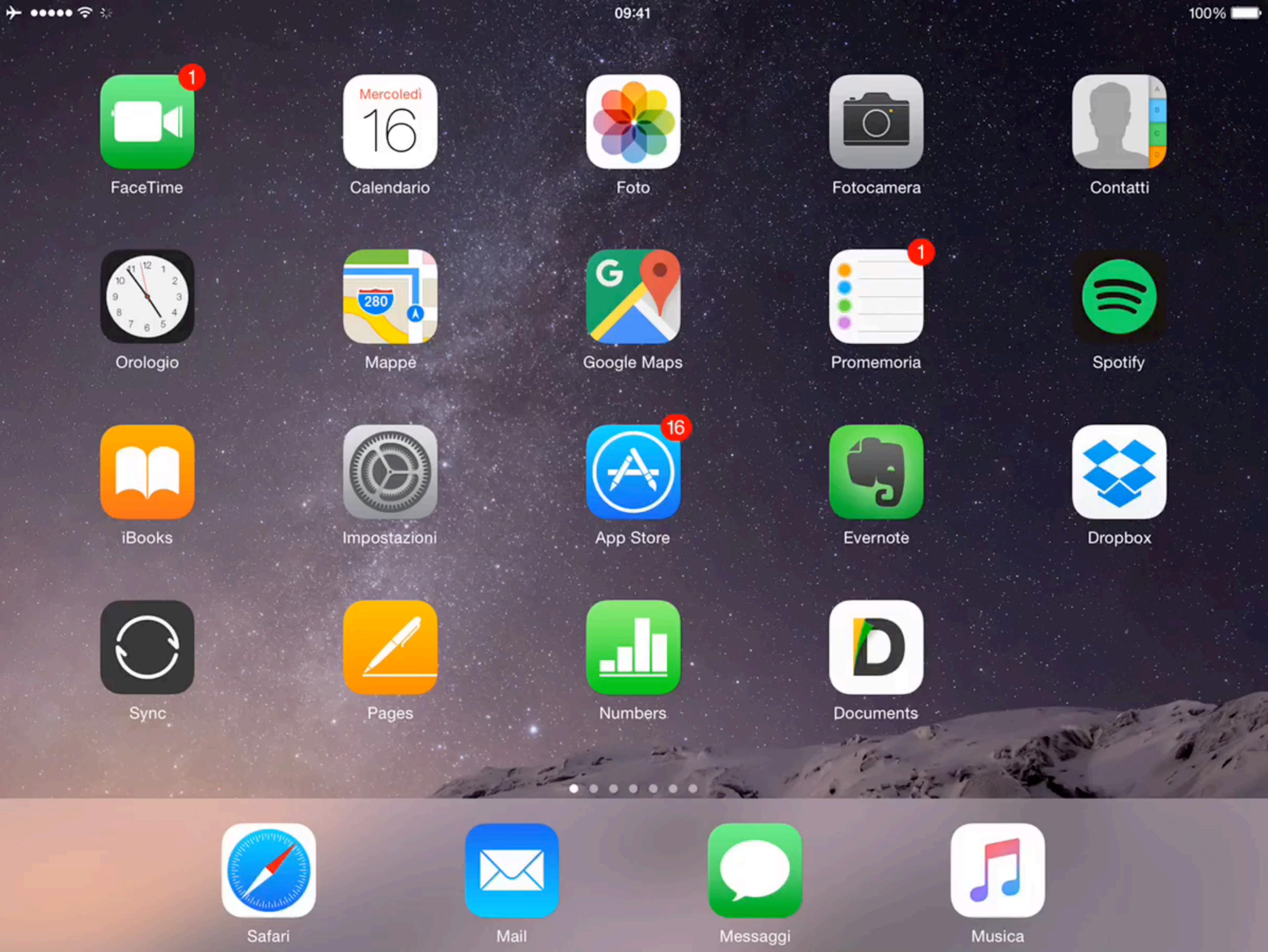
    // if (ImGui::CollapsingHeader("Checkboxes", nullptr, ImGuiTreeNodeFlags_DefaultOpen))
    // {
    //     ImGui::Checkbox("Test Checkbox 1", &model.checkBox);
    //     ImGui::Checkbox("Test Checkbox 2", &model.checkBox);
    //     ImGui::Checkbox("Test Checkbox 3", &model.checkBox);
    // }
    // if (ImGui::CollapsingHeader("Sliders", nullptr, ImGuiTreeNodeFlags_DefaultOpen))
    // {
    //     for (int i = 0; i < 3; ++i)
    //     {
    //         ImGui::PushID(i);
    //         ImGui::SliderInt("Test Integers", &model.array[i], 1, 10);
    //         ImGui::PopID();
    //     }
    // }
    // if (ImGui::CollapsingHeader("Text Inputs", nullptr, ImGuiTreeNodeFlags_DefaultOpen))
    // {

    //     ImGui::InputText("Single line of text", model.testText, 100);
    //     ImGui::InputTextMultiline("Multi Line", model.testText, 100, ImVec2(0, 0), ImGuiInputTextFlags_Allo
    // }
    // if (ImGui::CollapsingHeader("Colors", nullptr, ImGuiTreeNodeFlags_DefaultOpen))
}
```

Dear ImGui - Industrial Field

- Strong Branding
- Extremely fluid and responsive
- Unified experience between Desktop and Mobile
- Unified Cross Platform Experience
- Very common Remoting on Terminals (Robot Teach Pendant)





Closing Thoughts

- It works for us so it may work for you as well!
- Experiment!
- Create imgui wrappers for existing retained mode UIs?

Questions ?

Let's keep in touch!



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