



# Visual Programming for Hybrid User Interfaces

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# Mixed Reality UIs

- potential to address the need for proper system control
  - integration into VR UIs difficult and expensive
- combine virtual 3D content with real-world interfaces such as conventional 2D desktop interfaces
- => hybrid UIs
  - heterogenous display and interaction devices
  - provide "best" UI for diverse interaction tasks
- system control well understood in 2D desktop GUIs
- engineering problem with 2D-3D MR UIs: lack of development tools



## Thekla Software System: Overview

- "glue" that integrates the 2D and 3D components into a seamless hybrid user interface
- input event distribution between 2D and 3D components
- physical integration of 2D and 3D UIs
- visual programming support
- scripting support (Inventor, XML)

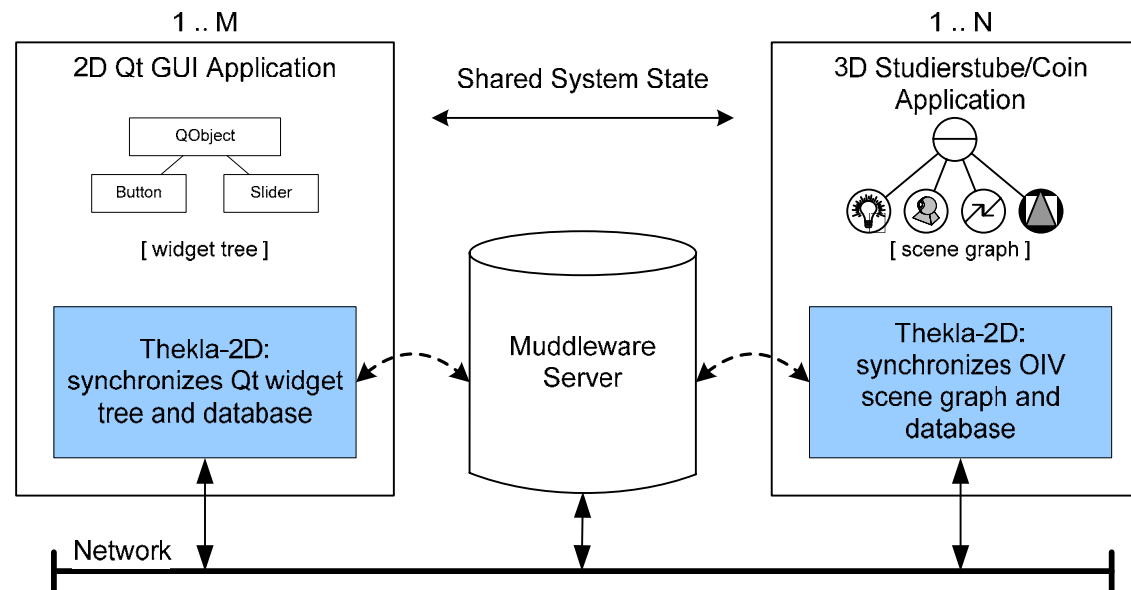


## Thekla Software System: Overview [2]

- extends the MR framework Studierstube
  - based on a number of mature components:
  - Coin3D: scene graph library
  - OpenTracker: tracking data flow library
  - Muddleware: blackboard communication tool
- uses Qt for cross-platform GUI development
  - excellent development tools
  - Qt designer: visual UI editor

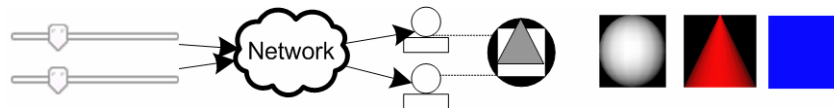
# Thekla 2D Component

- multiple GUIs and multiple scene graph components can be arbitrarily wired together
- system state is stored in a persistent central repository (Muddleware, XML)



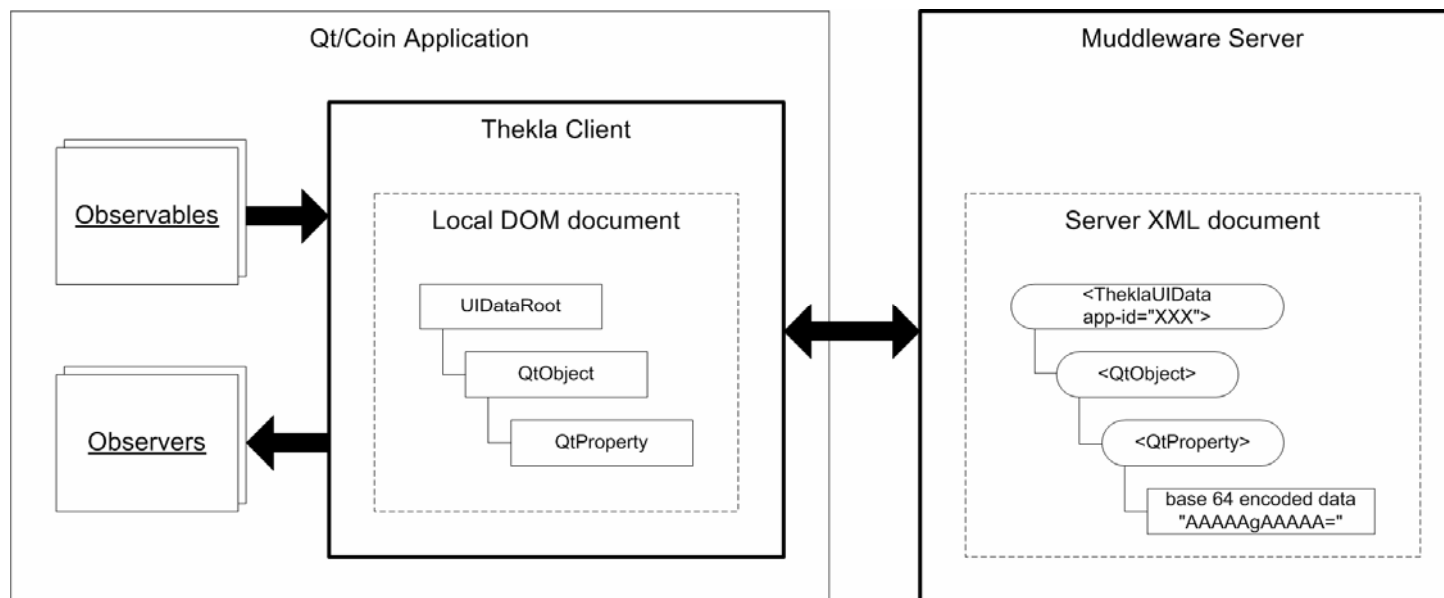
# Publish-Subscribe Pattern

- one-to-many connections between Qt and Coin application objects: observable => observer
- transparent data-driven synchronization
- existing class hierarchies used, no additional interfaces required
  - Qt: QObject class hierarchy (UI widgets)
  - Coin: fields, field lists (nodes and engines)
- connection example
  - Qt => Coin: 2D widgets manipulate 3D geometry



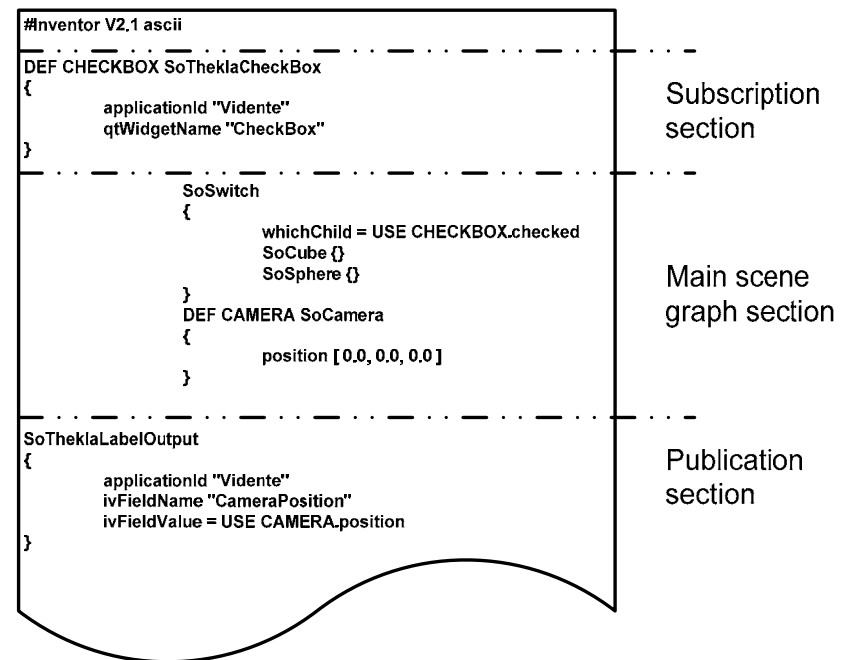
# Thekla Client API

- employed by 2D/3D application components
- provides methods to publish and subscribe observables and to establish connections



# Thekla Studierstube Components

- set of Coin3D engine classes
- allow to script connections directly in Inventor script files
- resulting scripts are devided into three sections



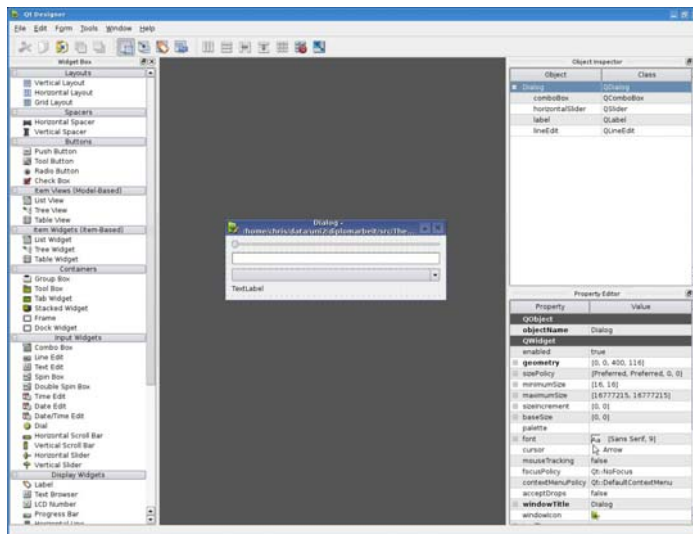


# Thekla Qt Designer Plugin

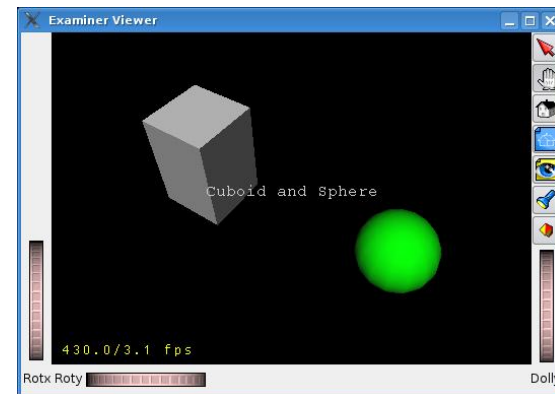
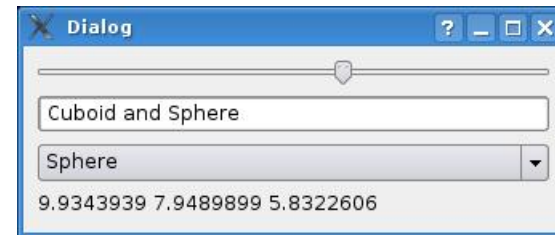
- integrates with Qt's visual programming frontend
- widgets created as part of a GUI design can be published as observables
- extends Qt Designer's C++ code generator
  - produces immediately executable and testable GUIs
  - scheduled observables are published at runtime
  - automatic synchronization of the system state through Thekla
- development process for Qt GUIs remains largely unaltered compared to desktop development

# Live Demos

Create 2D GUI application



Hybrid 2D/3D UI



# Thekla 3D Component

- same input device can be used to work in both the 3D and 2D world of the hybrid UI
- 3D tracked input device together with an arbitrary display surface => touchscreen interface
- allows operation of (unaltered) 2D desktop applications with any combination of 2D and 3D input devices



Tracking System



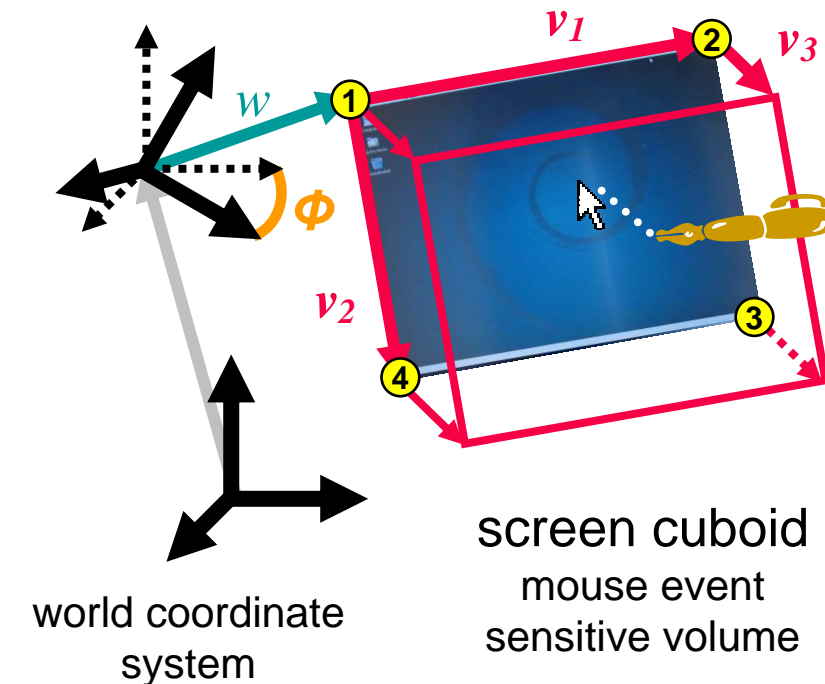
Input Device



Display Device

## Thekla 3D Component [2]

application screen  
coordinate system



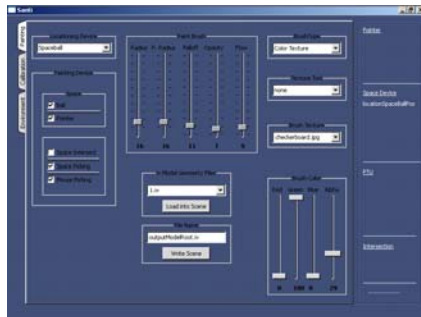
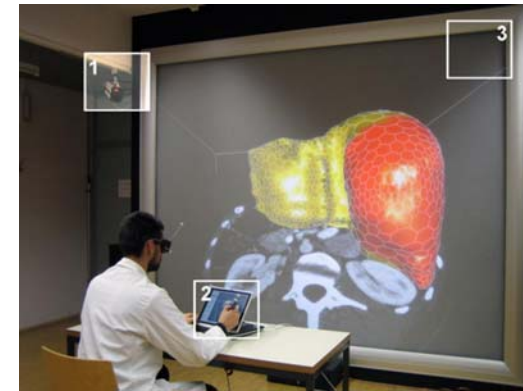
- "mouse position" device intersects the screen cuboid => mouse events are generated
- concurrent usage of multiple screens possible
- screens can be moved freely

# Examples

## Raffaello: "3D Painting"



## Liver Surgery Planning



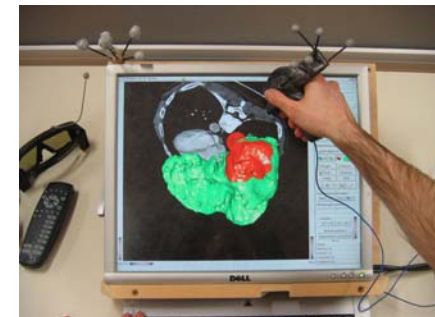
2D UI (system control): "select brush"



3D UI (painting application) "apply brush"



unified "hybrid" interaction device for 2D and 3D UI





# Summary

- hybrid user interfaces
  - 3D VR UI: selection and manipulation of 3D objects
  - 2D UI: well-suited for system control
- Thekla facilitates integration of 2D and 3D user interfaces into hybrid, distributed mixed reality applications
- input event distribution system
- visual programming support for the 2D part of the system
- physical integration: unified tracked input device for 2D and 3D UIs



# Visual Programming for Hybrid User Interfaces



Thanks for your attention!

Questions?





# References

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