CSc 165
Computer Game Architecture

2 - Input Handling

Overview

- **Device Types**
- **Device Abstractions**
- **Controllers**
- **Input Handling Packages**
- **Event Queues**
- **Input Action Commands**
  (making the inputs do things)

Types of Input Devices

- **Keyboard**
- **Mouse**
- **Joystick ("POV")**
- **"POV Hat Switch"**
- **Gamepad**
- **Paddle**
- **Steering Wheel**
- **Dance Pad**
- **Guitar**
- **WiiMote**
- **Kinect**
- **others?**

Input Handling Goals

Keep <u>games</u> device-independent

- **Game shouldn't contain hard-coded device details**
- **Game shouldn't fail when a particular device is absent (allow substitution)**

Keep <u>engine</u> device-independent

- **Engine components ***<u>should not</u>* **contain hard-coded device details**
  … isolate details in an *Input Manager*

Device Abstractions

Two fundamental device types:

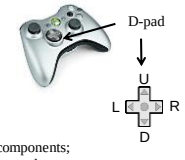
- **<u>Button</u> – returns ***<u>pressed</u>* **or ***<u>not pressed</u>***
  Frequently represented as 1.0 or 0.0
- **<u>Axis</u> – returns a *float***
  Two *types* of Axis:
  - **Continuous: returns a value in a *range***
    e.g. { -1 … 1 } or { 0 … 1 }
  - **Discrete: returns a value from a *set***
    e.g. [0, 1] or [-1, 0, 1]

  Can be absolute or relative

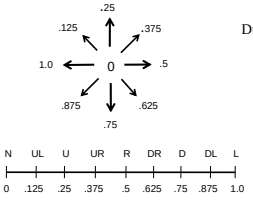
"D-pad" (Directional-pad) Axes

Discrete axis devices

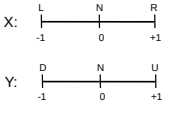
- Can have either *one* or *two* axes



Single-axis form: *one* component; returns *one* value:



Dual axis form: *two* components; *each* returns a value:



Controllers

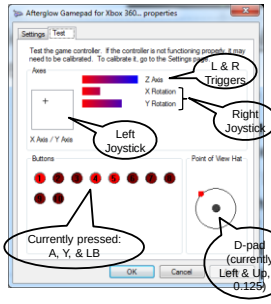
Most "devices" are really *collections* :

- Keyboard: collection of (e.g. 127) "buttons"
- Mouse: collection of (typically 1 to 3 or more) "buttons", plus two "axes" ('X' and 'Y')
- Gamepad: collection of buttons and axes
  - Multiple physical buttons
  - Joystick: two (continuous) "axes" (per joystick)
  - D-pad: one or two (discrete) "axes"
  - "POV hat switch": one or two (discrete) "axes"

Device collection == "Controller"

Controller Example: GamePad

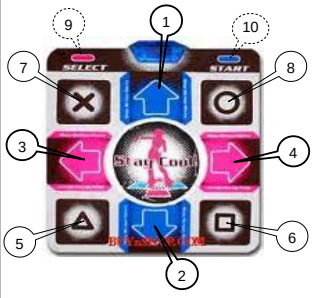
PDP *Afterglow* XBox-360 GamePad Controller

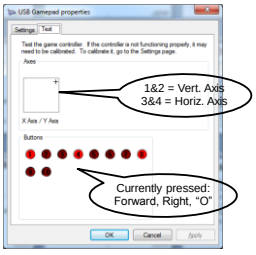


16 "devices": 10 Buttons, 2 Joysticks (4 continuous axes, each {-1..1}), 2 "Triggers" (combined as a single Axis {-1..1}), 1 D-pad (1 discrete axis: [0, .125, .25, … .875, 1])

ControlPanel -> Devices&Printers -> RIGHT-click the controller icon -> Game Controller Settings > Properties

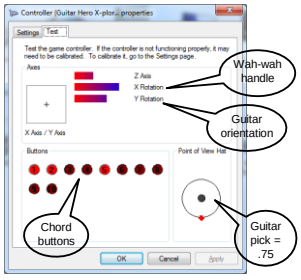
Controller Example: Dance Pad





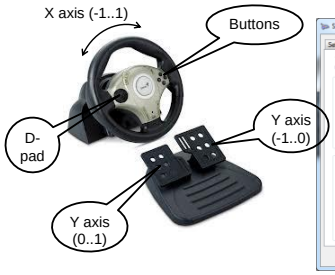
12 "devices": 10 Buttons, 2 discrete axes, each [-1, 0, 1]

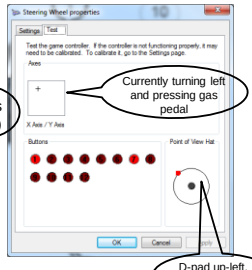
Controller Example: Guitar



16 "devices": 10 Buttons, 5 continuous axes, each {0..1}, 1 discrete axis, [0, .125, .25, .375, … .875, 1.0] (pick Off/Up/Down = [0, .25, .75])

Controller Example : Steering Wheel





15 "devices": 12 Buttons (0-11), 1 discrete axis (D-pad, "pov") [0, .125, .25, .375, … .875, 1.0], 2 continuous axes (X & Y) each [-1..1]

Accessing Game Controllers

`DirectInput`

- Windows-specific (part of Microsoft's *DirectX* framework)
- (deprecated)

`XInput`

- Microsoft API for Xbox 360 controllers
- No support for keyboards or mice

`OIS (Object-oriented Input System)`

- SourceForge (open source) project, mostly C++

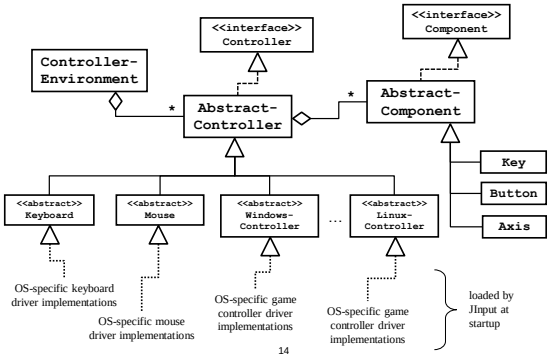
`JInput`

- Part of JGI (Java Gaming Initiative) framework (JOGL, etc.)
- Under negotiation with Jogamp
- Supports Windows, Linux, OS-X, AWT, etc.

Primary `JInput` Objects

- **`ControllerEnvironment`**
  Contains the collection of defined "controllers"
  - Examples: Keyboard, Mouse, Joystick, GamePad…
- **`Controller`**
  Contains a collection of "components" (input generators)
  Examples: button, key, slider, dial, controller
  Can also contain "rumblers" (output feedback devices)
- **`Component`**
  An object with a single *"range"*
  - Button: on/off
  - Key: pressed/notPressed
  - Axis: a value in some range

`JInput` Organization



Controller Attributes

- Name (human-readable)
- Type
  - Keyboard, Mouse, Fingerstick, GamePad, HeadTracker, Rudder, Stick, Trackball, Trackpad, Wheel, Unknown
- Array of (sub)-controllers
- Array of components
- Array of rumblers
- Event Queue

See code example for accessing controller attributes with JInput

Component Attributes

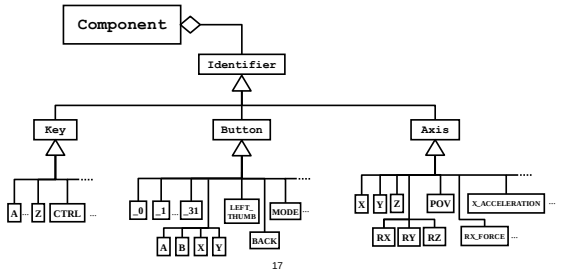
- Name (human-readable)
- "Identifier" (type)
  - Axis, Button, or Key
- Return value type
  - *Relative*: value is relative to previous return value
  - *Absolute:* value is independent of previous return value
- Return value range capability
  - *Analog*: allows more than two values
  - *Digital*: only two values allowed (e.g. a button)
- Dead zone value
  - Threshold before switching from 0 to non-zero
    (useful for joysticks: minor movement ignored)

See code example for accessing component attributes with JInput

Component ID

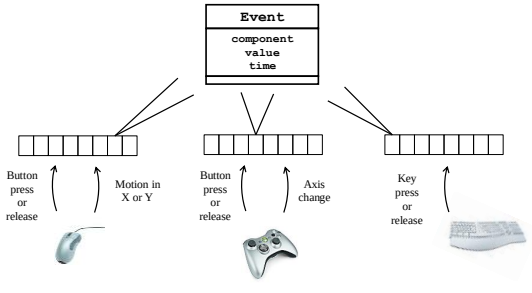
Every component has a *type identifier*

*predefined identifiers in Jinput javadoc for Component.Identifier.**



Input Events

Each controller has an ***event queue***



Simplifying Input Handling

Game goals:

- For each device component event, invoke some (game-specified) ***action*** associated with that event
- Hide details inside Game Engine

Examples:

- Gamepad Button 2 pressed → Fire Rocket
- Keyboard 'f' key pressed → Fire Rocket
- Joystick "X" axis moved → Change Camera View
- Guitar "Pick" axis "*down*" →

```
button = getCurrentChordButton();
if (button == displayedNote) {score++}
```


RAGE *InputManager**

Implements:

associateAction(controller, component, Action,…)

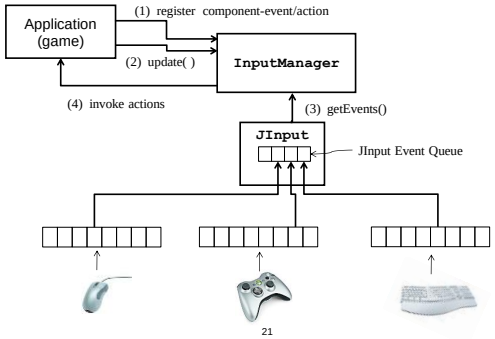
- **Registers a user-specified *action* corresponding to the given *controller* & *component***

update(float time)

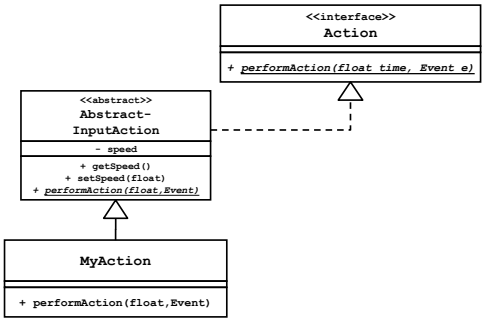
- **Polls the underlying device event queues**
- **Performs *event dispatch (action invocation)***

**adapted from SAGE*

RAGE *InputManager* (continued)



Defining an `Action` interface



Button/Key Action *Types*

Not all actions should be invoked on every component state-change

- On Press Only:
  `Fire_Missile_Action`, `Reset_Camera_Action`
- On Press And Release:
  `Toggle_Running_Action`
- Repeatedly while held down:
  `Move_Forward_Action`

Modifier Actions

Actions can contain *modifier actions.*

Example:

MoveFoward is a standard Action Object

RunAction is also an Action Object, but its purpose is to modify how fast *MoveForward* operates

Usage example:

- *Construct both actions, associate them both with user inputs.*
- *Pass the RunAction object to MoveForward during construction*
- Invoking RunAction modifies state information
- When invoking MoveForward, its behavior depends on the state information in RunAction

(see code example)